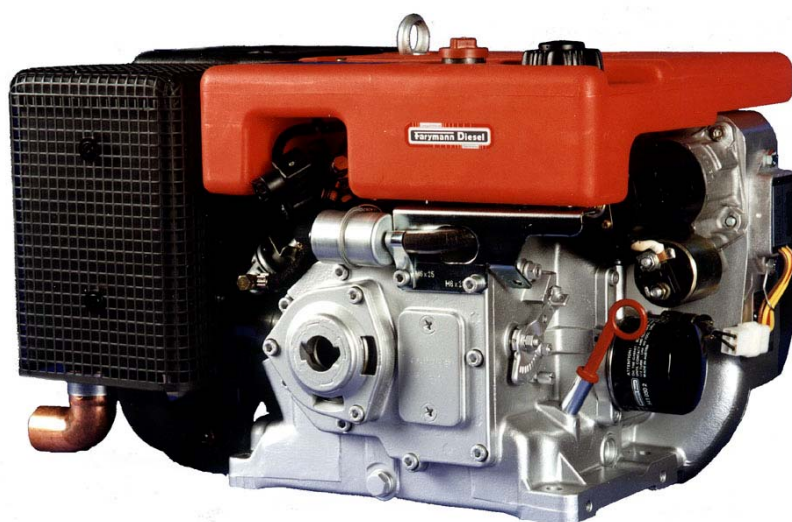




REPAIR MANUAL

Diesel Engines **37E**
43E/F



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We congratulate you on your choice of a **FARYMANN** engine and wish you much pleasure with this German quality product.

These operating instructions are based on the latest state of technical development. In preparing them, every effort has been made to avoid errors. However, we accept no liability for any errors of presentation or description, nor for any omissions. Modifications may also occur because of ongoing technical developments. We reserve the right to make modifications without giving prior notice.

Everyone responsible for the installation, commissioning, operation, maintenance or repair of the engines must read and follow the operating instructions and particularly the "**Safety**" chapter.

The engine is built according to the state-of-the-art, and in compliance with recognised safety regulations. Nevertheless, while the engine is in use, there may be physical or mortal dangers to the user or to third parties, and also damage to the engine and to other property. For these reasons, the engine must only be used when it is in perfect technical condition, and when those involved are aware of the dangers and the safety precautions. In particular, malfunctions which could impair safety must be rectified immediately. The engine must only be used as intended. **FARYMANN DIESEL GmbH** is not responsible for damage resulting from incorrect use. Such risk is borne solely by the user.

Correct use also includes following the operating instructions and adhering to the operating, servicing and maintenance conditions. The engine must only be operated and serviced by reliable, trained personnel in compliance with the relevant accident prevention regulations as well as other generally-recognised rules of safety and occupational health.

FARYMANN DIESEL GmbH accepts no liability for any damage resulting from unauthorised conversions or modifications to the engine. Replacement parts must meet the technical requirements specified by **FARYMANN DIESEL GmbH**. This is always guaranteed if original replacement parts are used. Fitting and/or using parts and accessories not supplied by **FARYMANN DIESEL GmbH** may have a detrimental effect on your engine under certain circumstances.

FARYMANN DIESEL GmbH accepts no liability whatsoever for any damage resulting from the use of non-original replacement parts or accessories.

1. General Information, Handling

All **FARYMANN DIESEL** engines are 4 stroke, direct injection diesel engines. They are built as single cylinder engines in vertical and horizontal cylinder configuration. The direct injection guarantees an outstanding level of efficiency, with low fuel consumption and excellent cold starting behaviour. Bosch fuel injection equipment is used on all engines. A precision centrifugal governor ensures accurate speed (RPMs) and load regulation. For air cooling, a noise-optimised, maintenance-free flywheel fan circulates the cooling air through the cooling fins on the cylinder and the cylinder head.

1.1 Organisation and Use of this Repair Manual

The descriptions, data and illustrations refer to those assembly and adjustment procedures where **FARYMANN** engines differ from ordinary diesel engines.

Well-known procedures (such as how to set the start of delivery) are not described in detail.

- It is assumed that all work on the engine will be carried out by competent staff who have received training.
- Special tools must be available, as described in the manual, together with good-quality standard tools.

1.2 Service

- If you have any further questions about the Repair Manual, we recommend you to contact your nearest **FARYMANN** Service Centre.
- Circular letters and training courses ensure that our service personnel have an answer to every question. Please ask for a list of all our service locations from your own **FARYMANN** Service Centre.

1.3 After Sales - Service: FALKE - Spare Parts Program

"Service, Quality and Progress"

is our motto. This is why we have developed our very own computer-aided "FALKE" Service System.

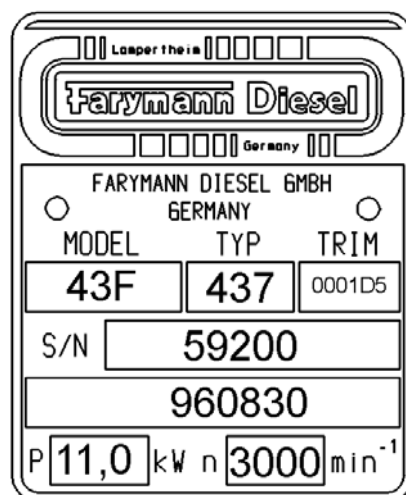
The FALKE System makes it possible for **FARYMANN's** world-wide network of distributors to **satisfy all spare parts and service requirements quickly and reliably, ensuring that we maintain a close relationship with our customers.**

GENERAL INFORMATION, HANDLING

1.4 Engine, Model and Type Designation

Every engine can be unmistakably identified using the manufacturer's nameplate. As well as the clearly defined 12-digit code number, this refers to the order number (SN) and the date of construction. This information must always be provided when making any enquiries or complaints, etc.

As of July 1985, the consecutive engine number is also imprinted on the crankcase.

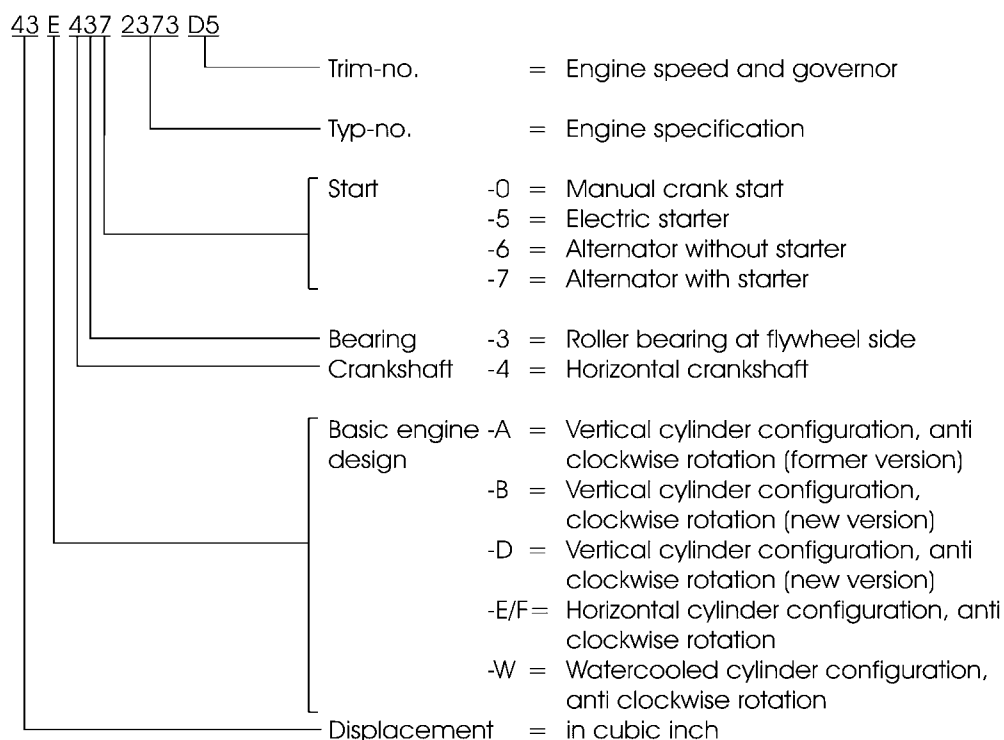


As of July 1982, the type designation (a 12-digit code number) is used in addition to the series number (SN = Order Number). (See manufacturer's nameplate).

e.g. **43E437 2373 D5**

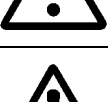
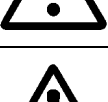
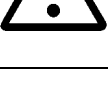
95 03 20

Date of Production



SAFETY INSTRUCTIONSATA

1.5 Safety Instructions

	Only use transport devices specified by the manufacturer, and only follow hoisting instructions specified by the manufacturer.
	When handling fuels, lubricants and other chemical substances, follow the safety regulations which apply to the product.
	Do not smoke when handling inflammable fuels or lubricants.
	Vapours from lubricating oil or fuel may catch fire if they come into contact with sources of ignition.
	Be careful when handling hot or corrosive fuels, lubricants or other substances (risk of burning or scalding).
	Never carry out maintenance and repair work when the engine is running. Ensure that the engine cannot start unintentionally.
	Before turning the engine over, make sure that nobody is in the danger area. When you have finished working on the engine, always check that the safety devices have been refitted, and that all tools have been removed from the engine.
	Never carry out any work on safety valves (e.g. modification of the spring tension). Defective safety valves must be replaced with new ones.
	When disposing of used fuels, lubricants and filters, follow the regulations which apply locally.
	Before or when you start the engine, check: – all lines, hoses and screwed connections for leaks; – safety devices for completeness and ability to operate.
	When starting the engine by hand, only use the starting device specified by the manufacturer (starting handle with kick back limiter, recoil starting) and follow the handling instructions. Never use cold starting aids based on ethyl oxide.
	Because of the explosion hazard, it is forbidden to start up a compressed-air start engine with combustible gases (fuel gases) or oxygen, even in an emergency.

SAFETY INSTRUCTIONS

1.5 Safety Instructions

	Only operate IC engines in enclosed areas if there is adequate ventilation. Before you start the engine in an enclosed environment, make sure that there is sufficient ventilation.
	Ensure that the engine only slows down to full stop after 10 - 20 seconds!
	If there are any safety devices on the engine, or on the machine into which the engine is built, they must be refitted when the maintenance and repair work has been finished.
	Before starting any work on the electrical components, the power supply to all live parts must be cut off.
	Only carry out maintenance and repair work when the engine parts are in a stable position.
	Liquids ejected under high pressure (such as fuels or oils) may penetrate the skin and cause severe injuries.
	To carry out cleaning work on the engine, always use a non-combustible detergent, or one which has a flash point of more than 65 °C.

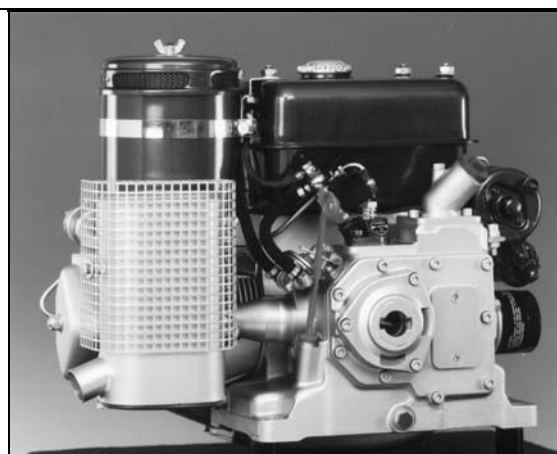
CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

TECHNICAL DATA

2. Technical Data



37E / 43E-Engine



43F-Engine

Engine Type	37E	43E	43F
Design	horizontal		
Number of Cylinders	1		
Bore	95 mm Ø		
Stroke	100 mm		
Cubic capacity (piston displacement)	708 cm ³		
Direction of rotation (looking at power take-off side)	anti clockwise		
Max. power F (DIN 70020)	9,1 kW (12,4 HP)	10,6 kW (14,4 HP)	11,4 kW (15,5 HP)
IFN-ISO (DIN 6271)	8,3 kW (11,3 HP)	9,7 kW (13,2 HP)	11,0 kW (15,0 HP)
ICFN-ISO (DIN 6271)	7,5 kW (10,2 HP)	8,7 kW (11,8 HP)	9,9 kW (13,5 HP)
Max. torque (DIN 70020)	31 Nm at 2200 RPM	37 Nm at 2000 RPM	40,6 Nm at 2300 RPM
Max. speed	3000 RPM		
Mean piston speed	10 m/s at 3000 RPM		
Compression ratio	1 : 19		
Valve clearance, exhaust valve	0,1 mm		
intake valve	0,1 mm		
Tank capacity	8,3 l	8,3 l	7,5 l
Lubricating oil volume (sump capacity)	2,1 l		
Lubricating oil consumption	1,0 g/kWh		
Starter rated voltage	12 V		
battery capacity required	55Ah		
Weight	87 kg		
Overall dimensions (H * W * L)	approx. 500 mm * 440 mm * 590 mm		approx. 360mm * 430mm 580mm
Permissible tilt during operation :			
longitudinal	15 °		
lateral	15 °		

TECHNICAL DATA

2.1 Construction Data, Consumptions and Pressures

		Technical Data								Table 1			
Engine Type		37E				43E				43F			
Construction data	dimension												
System	*	four stroke											
Combustion Procedure	*	direct injection											
Cooling System	*	air-cooled											
Design / Configuration	*	1-cylinder / horizontal											
Bore	(mm)	95											
Stroke	(mm)	100											
Displacement	(cm ³)	708											
Compression Ratio	*	1 : 18,7 - 1 : 20,5				1 : 17.5 - 1 : 19,1				1 : 19 - 1 : 19,5			
Temperatures	dimension												
Permissible air intake temperature (max.)	(°C)	50											
Permissible exhaust gas temperature (max)	(°C)	580											
Permissible cooling air temperature (max.)	(°C)	50											
Permissible fuel temperature (max.)	(°C)	80											
Permissible lub. oil temperature (max.)	(°C)	130											
Consumptions (at IFN Output)													
Specific fuel consumption	(g/kWh)	268	262	280	*	258	251	280	*	225	217	235	*
Fuel tank content	(l)	8,3								7,5			
Feed pump (max. lift)	(mm)	300											
Fuel	*	to DIN 51 601 / ASTM D 975-77 + 2D/BS 28669 1970 A1 + A2											
Specific lub. oil consumption	(g/kWh)	1											
max. lub. oil capacity	(g/l)	1860 / 2,1											
Topping up volume lower-upper mark	(g/l)	710 / 0,8											
Lub. oil quality	*	HD oil: minimum quality CC; better, CD quality (API-spec.) and multigrade oils											
Pressures													
Injector setting	(bar)	175								250			
Oil pressure (max.)	(bar)	5											
Permissible air intake vacuum	(kPa)	2											
Permissible exhaust gas back pressure	(kPa)	5											

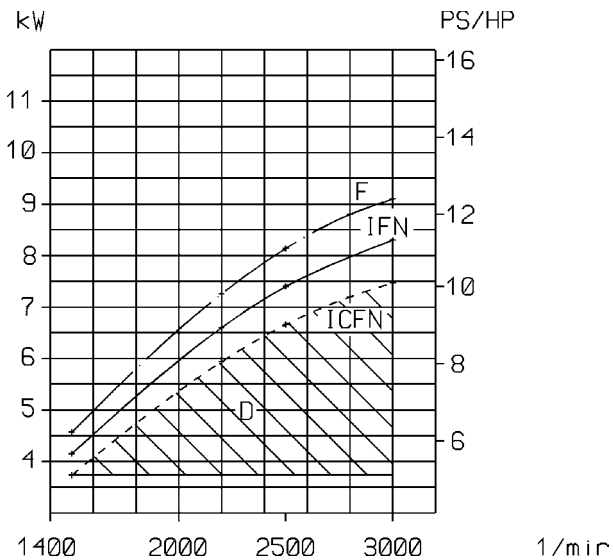
TECHNICAL DATA

2.1 Construction Data, Consumptions and Pressures

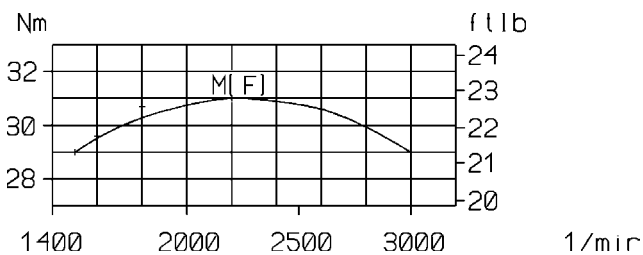
		Technical Data								Table 2			
Engine Type		37E				43E				43F			
Adjustment Data													
Valves													
Inlet opens BTDC	*	38°-42° = 103 - 114 mm				38°-42° = 103 - 114 mm				40°-55° = 108 - 149 mm			
Exhaust closes ATDC	*	50°-55° = 135 - 148 mm				50°-55° = 135 - 148 mm				55°-60° = 149 - 162 mm			
Flywheel diameter	(mm)	310											
Injection pump: end of delivery, plunger with control edge “above“													
Engine RPMs	(min ⁻¹)	1500	1800	2000	2400	1500	1800	2000	2400	1500	1800	2000	2400
End of delivery BTDC	(mm)	21	24	26	30	24	27	29	33	*	*	*	*
Engine RPMs	(min ⁻¹)	2500	2800	3000	3600	2500	2800	3000	3600	2500	2800	3000	3600
End of delivery BTDC	(mm)	32	35	37	*	35	38	40	*	34	36	39	*
Injection pump: start of delivery, plunger with control edge “below“ (engines for generator and pump drive)													
Engine RPMs	(min ⁻¹)	1500	1800	3000	*	1500	1800	3000	*	*	*	*	*
Start of delivery BTDC	(mm)	*	*	*	*	*	*	*	*	*	*	*	*
Valve clearance (cold) inlet and outlet valve	(mm)	0,1											
Repair Data	Dimension												
Inlet valve recedes by:	(mm)	0 - 0,1				0 - 0,1				2,5 - 2,6			
Exhaust valve recedes by:	(mm)	0 - 0,1				0 - 0,1				2,5 - 2,6			
Piston protrudes by:	(mm)	0,635 - 0,9				0,635 - 0,9				0,635 - 0,9			
Gap measurement	(mm)	0,55 - 0,865				0,55 - 0,865				0,55 - 0,865			
Piston ring joint	(mm)	0,4 - 1,0				0,4 - 1,0				0,4 - 1,0			
Crankshaft plain bearing clearance - new condition	(mm)	0,03 - 0,07				0,03 - 0,07				0,03 - 0,07			
Crankshaft plain bearing clearance - wear limit	(mm)	0,1				0,1				0,1			
Connecting rod plain bearing clearance - new condition	(mm)	0,03 - 0,07				0,03 - 0,07				0,03 - 0,07			
Connecting rod plain bearing clearance - wear limit	(mm)	0,13				0,13				0,13			
Crankshaft end play	(mm)	0,05 - 0,15				0,05 - 0,15				0,05 - 0,15			

2.2 Output, Torque, Consumption

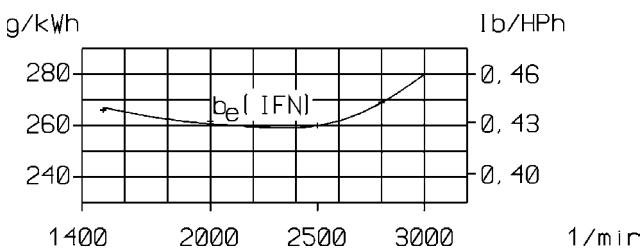
37E Leistung / Output / Puissance / Potencia



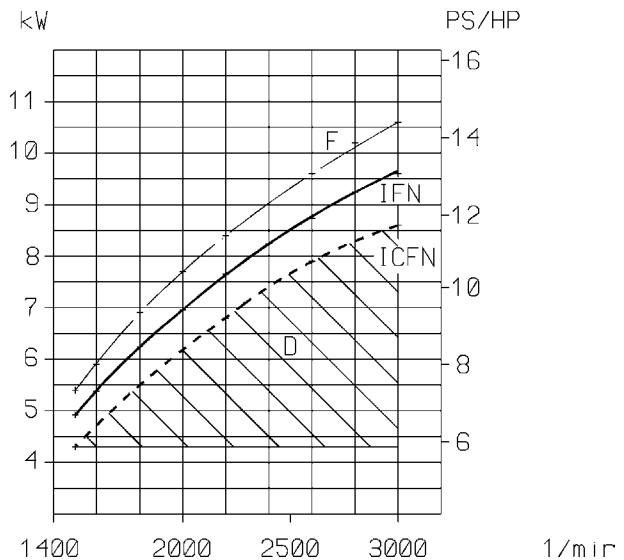
Drehmoment / Torque / Couple / Par



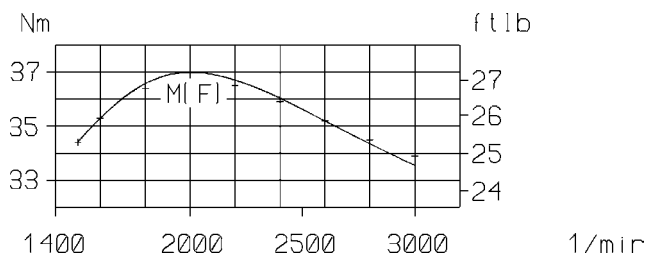
Verbrauch / Consumption / Consommation / Consumo



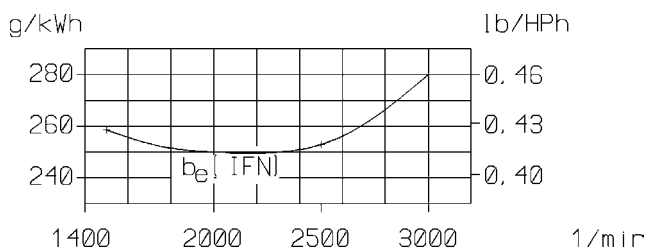
43E Leistung / Output / Puissance / Potencia



Drehmoment / Torque / Couple / Par



Verbrauch / Consumption / Consommation / Consumo



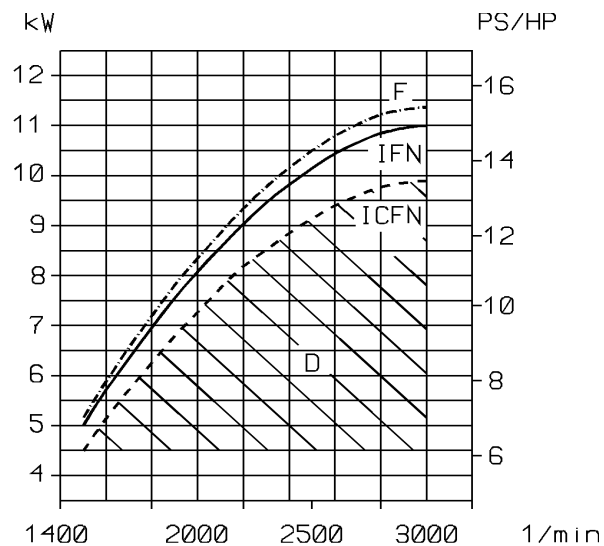
DIN ratings

- F Vehicle rating: intermittent duty at variable speed and load.
- IFN-ISO DIN-ISO 3046 Blocked useful performance for intermittent loads.
- ICFN-ISO DIN-ISO 3046 Standard performance, blocked continuous useful performance for constant RPMs and constant load.
- D Continuous operation: - contact factory for use beyond the limits indicated.
- Decrease of approx. 1% for every 100 m altitude and approx. 2% for every 5°C above 20°C
- Rating certified within tolerance of 5% after engine has been run in with standard air filter and exhaust muffler.

TECHNICAL DATA

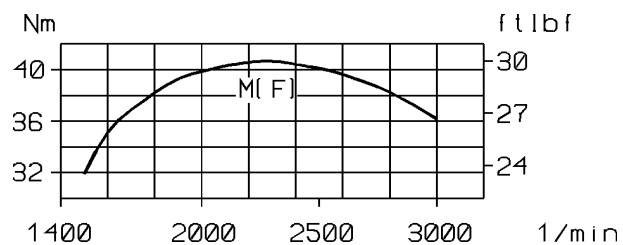
2.2 Output, Torque, Consumption

43F Leistung / Output / Puissance / Potencia



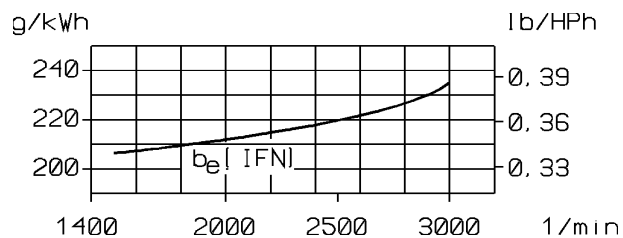
The values shown are related to the optimal load setting at the corresponding nominal engine speed.

Drehmoment / Torque / Couple / Par



$M_{\max} = 40,6 \text{ Nm}$ at RPMs of 2300 min^{-1} .

Verbrauch / Consumption / Consommation / Consumo



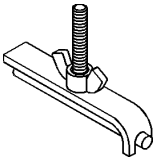
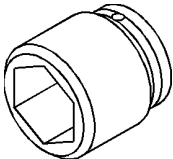
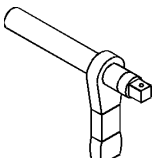
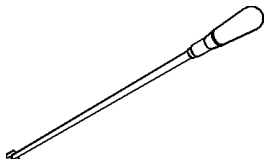
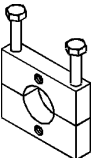
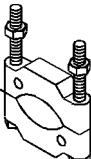
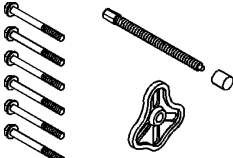
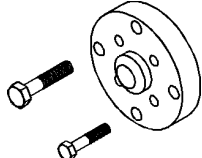
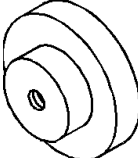
TECHNICAL DATA

2.3 Screws - Tightening Torques, Sealing and Adhesive Materials

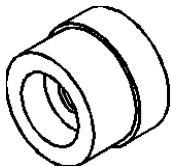
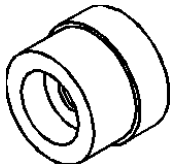
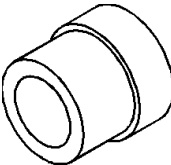
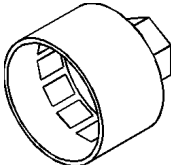
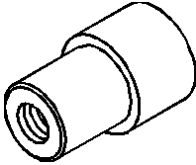
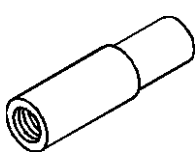
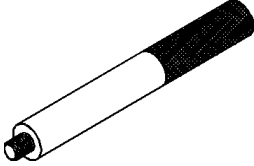
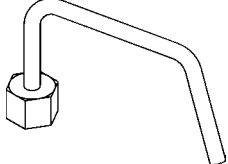
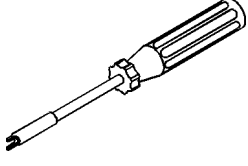
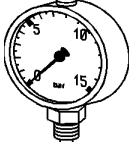
		Technical data		Table 1
Engine type		37E	43E	43F
Tightening torques				
Cylinder head torque / wrench width	(Nm) (mm)	52 - 56 / 17	52 - 56 / 17	52 - 56 / 17
Rocker bracket torque / wrench width	(Nm) (mm)	42 - 46 / 17	42 - 46 / 17	*
Bearing cover torque / wrench width	(Nm) (mm)	42 - 46 / 17	42 - 46 / 17	42 - 46 / 17
Connecting rod torque / wrench width	(Nm) (mm)	58 - 62 / 17	58 - 62 / 17	58 - 62 / 17
Nozzle holder torque / wrench width	(Nm) (mm)	20 - 23 / 13	20 - 23 / 13	20 - 23 / 13
Injection pump torque / wrench width	(Nm) (mm)	20 - 23 / 13	20 - 23 / 13	20 - 23 / 13
Delivery valve torque / wrench width	(Nm) (mm)	34 - 39 / 22	34 - 39 / 22	34 - 39 / 22
Flywheel torque / wrench width	(Nm) (mm)	390 - 410 / 46	390 - 410 / 46	390 - 410 / 46
Oil filter plate torque / wrench width	(Nm) (mm)	20 - 23 / Inbus	20 - 23 / Inbus	20 - 23 / Inbus
Maximum operation angles				
Longitudinal (in dir. of crankshaft)	(deg.)	15	15	15
Transverse	(deg.)	15	15	15
Sealing and adhesive materials				
Text Code		Type		
A		Loctite 573		
B		Loctite 270		
C		Loctite 415		

SPECIAL TOOLS

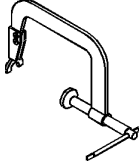
3. Tools

Part No.	Description	Use	
748.115.6	Fuel line clamp	to clamp fuel supply lines	
748.154.2	Hexagonal socket wrench, 46 mm	for flywheel nuts	
748.128.4	Drive wrench	for use with socket wrench, 748.154.2	
748.108.5	Special screw driver	to adjust governor spring nuts	
748.132.6	Crankshaft race puller	use with part no. 748.136.2 to pull off main bearing race from crankshaft	
748.137.2	Crankshaft gear wheel puller	use with part 748.136.2 to pull off crankshaft gear wheel	
748.136.2	Puller plate	use with parts 748.132.6 and 748.137.2	
748.122.6	Flywheel puller	to loosen flywheel	
748.119.4	Bearing driver	to press in crankshaft roller bearing and shaft seal	

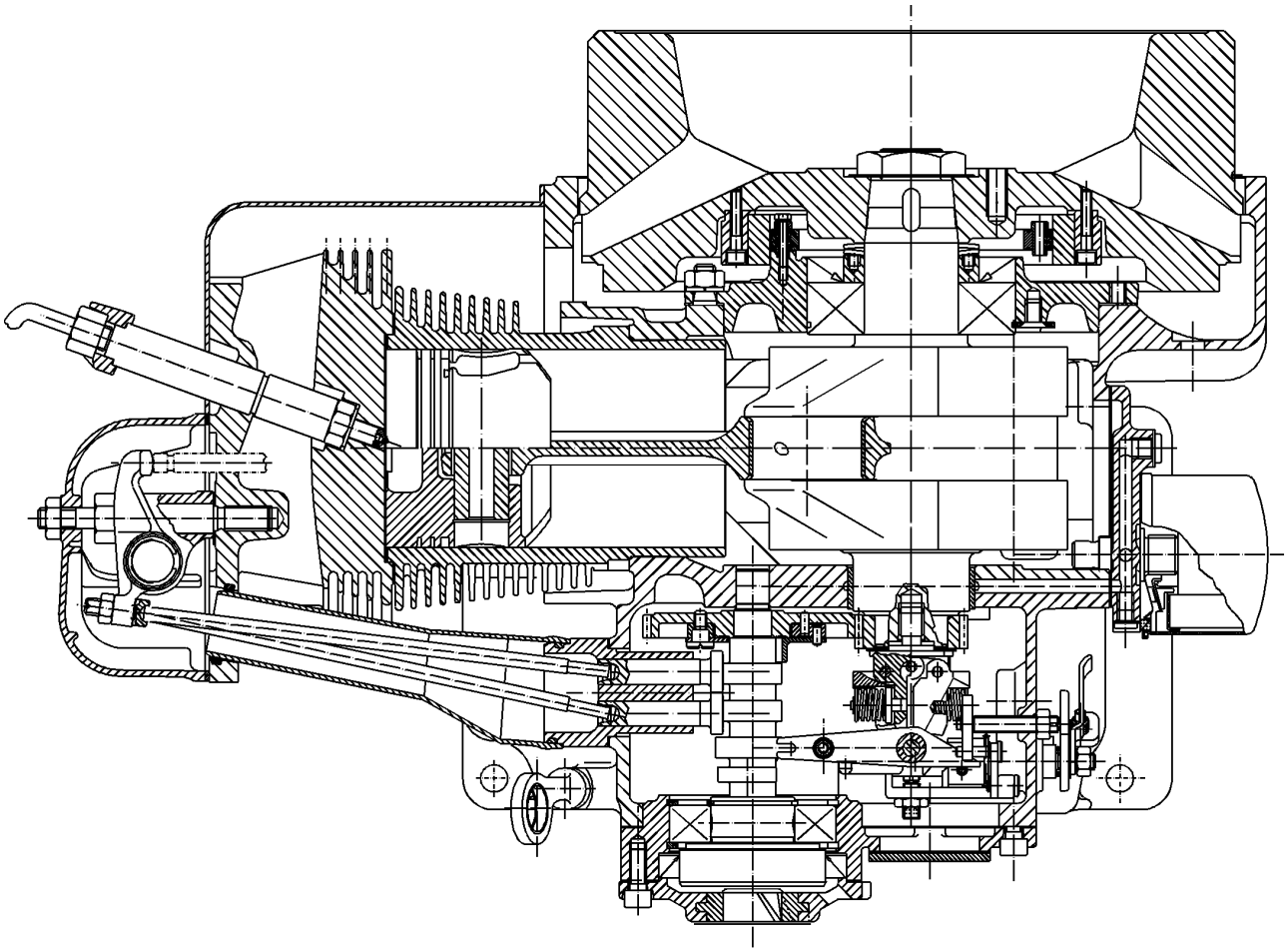
SPECIAL TOOLS

748.120.4	Bearing driver	to press the crankshaft bearing bushes in and out	
748.121.4	Bearing driver	to press the camshaft in and out	
748.124.4	Bearing driver	to press out the crankshaft roller bearing	
748.173.2	Oil filter wrench	to remove the full flow oil filter	
748.172.4	Bearing driver	to press the little end bearing bush in and out (connecting rod)	
748.129.4	Bearing driver	to press the regulator shaft bearing bush in and out	
37E/43E: 748.125.4 43F: 748.211.4	Guide punch	to press the valve guides in and out	
748.097.6	Drop tube	to measure the injection timing	
748.192.4	Slotted screw driver	to set the adjustment	
748.126.2	Oil pressure gauge	to measure the oil pressure	

SPECIAL TOOLS

748.131.5	Valve spring lifter	to remove and fit the valve springs	
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TECHNICAL DESCRIPTION



Presentation : 43E – engine

4. Technical Description

Diesel engine models 37E / 43E/ 43F are horizontal, air-cooled, single-cylinder, four-stroke diesel engines with direct injection. The engines have oil pressure forced lubrication. The fuel injection pump and the valves are controlled by the camshaft which is driven by the crankshaft. The fuel injection pump (self-venting fuel system) is driven directly while the valves are driven by push rods and rockers. An electric starter and a manual starting device are provided to start the engine. The engines are equipped with a fully automatic decompression system and a fully automatic starting enrichment quantity. Models 37E / 43E are available with a dry type air filter or an oilbath air filter.

43F – engines meet 2000 U.S. EPA – Limits and U.S. MSHA – exhaust-emission-regulations.

4.1 Applications

Diesel engine models 37E / 43E / 43F are suitable for the following applications:

- construction machinery
- power-generating sets
- agricultural machinery
- water pumps
- compressors
- fork lift drives, etc.

Special applications

Auxiliary Power Units, Military

5. Dismantling and Assembly Procedures on the Basic Engine

5.1 Basic Requirements

- The aim of this Repair Manual is to provide help with carrying out repairs to the engine.

The requirements for this are as follows:

- Trained specialist staff (of at least the minimum legal age);
- and a workshop where the necessary equipment, standard tools and special tools are available
- A well-lit, unrestricted working area, free from dirt and swarf, will make the work considerably easier.
- Clean the engine thoroughly before dismantling it.
- Attention must be paid to all the information and warning notices which have been affixed.
- Particular care is called for in the vicinity of rotating, moving or hot parts.



ATTENTION

This symbol is used whenever failure to comply precisely with instructions or procedures may cause accidents which can result in injuries or death.



CAUTION

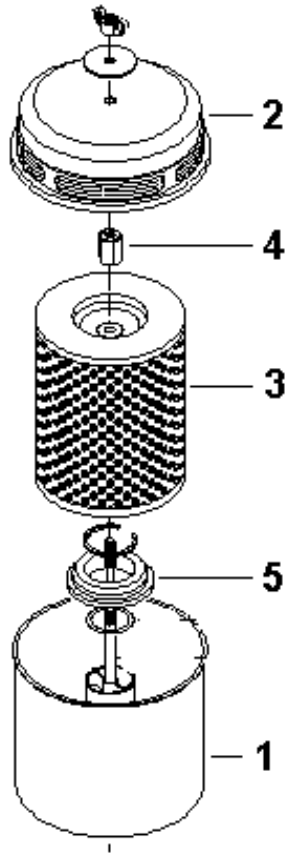
This symbol is used whenever failure to comply precisely with instructions or procedures may cause damage to the engine.



Advice and tips about special features when handling the engine.

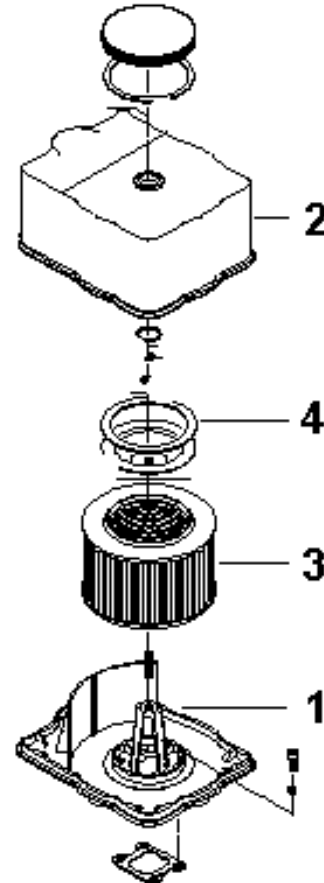
5.2 Intake Manifold (on 37E / 43E only)

Airfilter-Assy 37E / 43E



1. Filter base
2. Cover with preliminary filter
3. Strainer
4. Fitting hex-nut
5. Centering ring

Airfilter-Assy-Anbau 43F



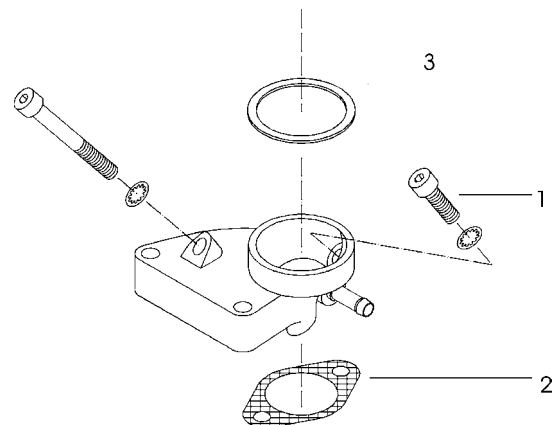
1. Filter-base
2. Cover
3. Strainer
4. Fastening strainer-cover

Intake elbow, 37E / 43E - engines



Attention:

- The socket head cap screw M 8x25 (1) must be fitted using "Loctite 415" adhesive (C).
- Generally renew the seal (2+3) 847.192.4.

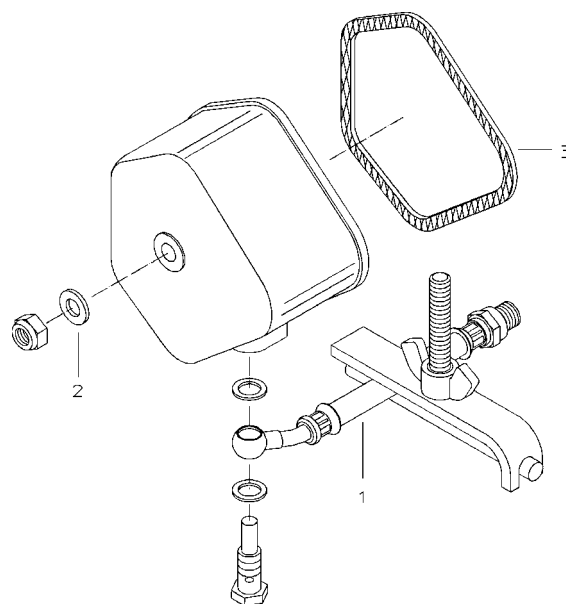


5.3 Valve Cover with Oil Return Line

37E / 43E – engines :

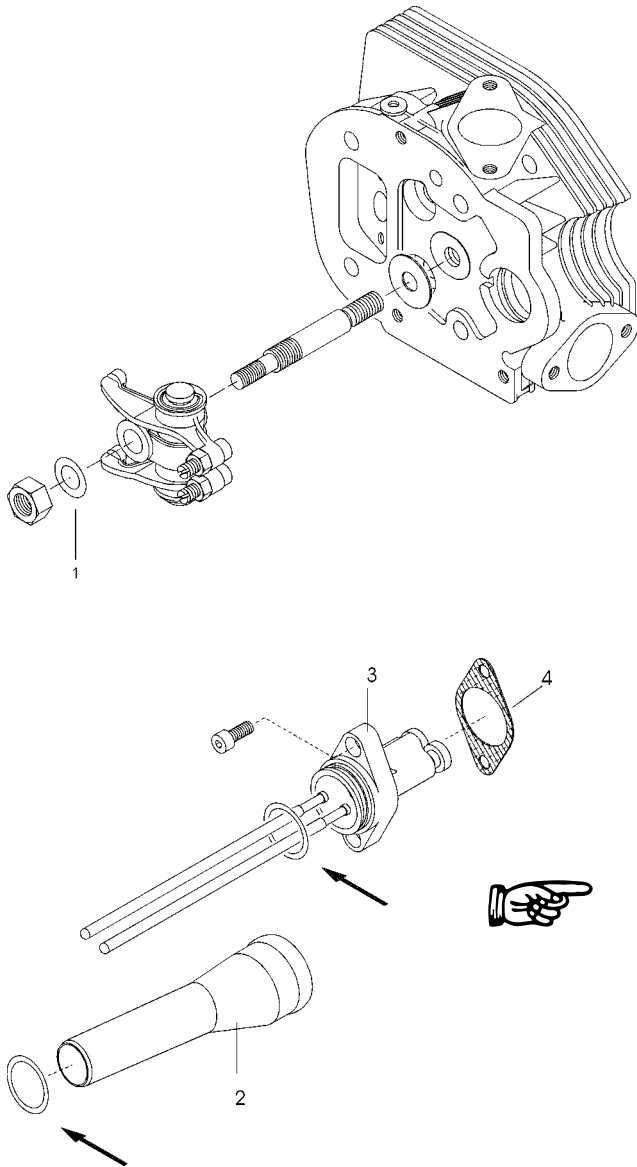
Drain the engine oil.

- Before dismantling, seal the oil return line (1) using clamp "748.115.6".
- The PVC sealing washer (2) can be used several times.
- Generally renew the valve cover seal (3).



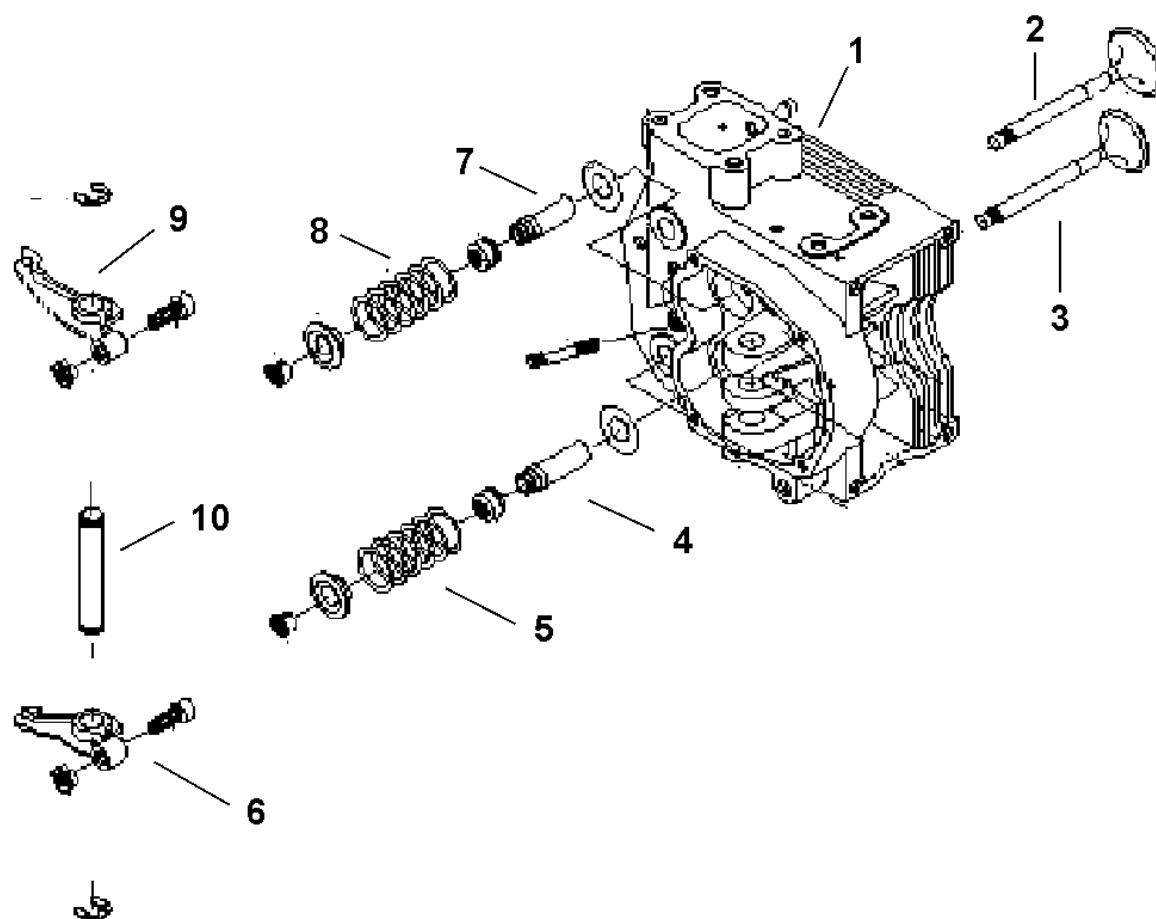
5.4 Rocker Mechanism, Valve Control

5.4.1 37E / 43E - Assy



- Completely dismantle the rocker bracket.
- 43F see page 43 no. 3.12.1
- When assembling, it is absolutely essential to insert the steel shim (1).
- Centre the rocker bracket.
- Carry out the assembly, using the tightening torque shown in the list.
- ALL ENGINES :
- Push rods of different lengths with tapered rod ends.
- Always fit tapered rod ends on the tappet side.
- Longer push rod - exhaust valve, position relative to engine mounting side.
- The push rod sheath (2) can be removed from the partly-dismantled engine (after the tappet guide (3) has been removed).
- Exchange the O-ring seals if necessary.
- Fit the tappet guide, using “Loctite 573” (A) sealing agent for the socket head cap screw.
- Generally renew the tappet guide surface seal (4).
- Before fitting the push rod sheath (2), make the two O-ring seals oil-dry and grease them slightly.
- The fitted push rod sheath might be moved out of position to start with, so check that the fit is correct.

5.4.2 Cylinderhead assy 43F – engine



- | | |
|--------------------------|-------------------------|
| 1. Cylinderhead | 6. Rocker arm, exhaust |
| 2. Intake valve | 7. Valve guide, intake |
| 3. Exhaust valve | 8. Valve spring, intake |
| 4. Valve guide, exhaust | 9. Rocker arm, intake |
| 5. Valve spring, exhaust | 10. Rocker shaft |

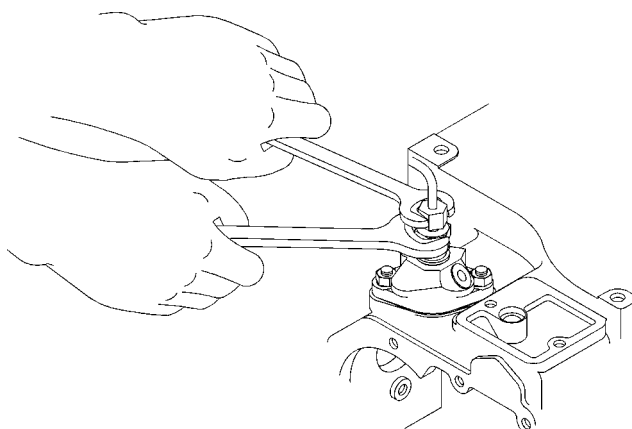
5.5 Injection system



ATTENTION

Pressure Line:

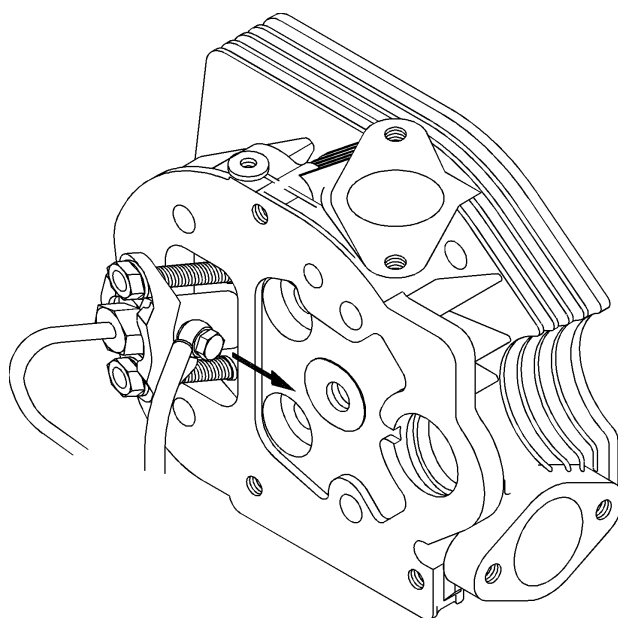
- When loosening the pressure line, use wrench SW22 to hold the delivery valve.



ATTENTION

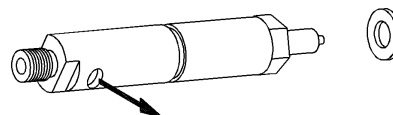
Injection nozzle

- Always remove the nozzle seal from the cylinder head seat and renew it.

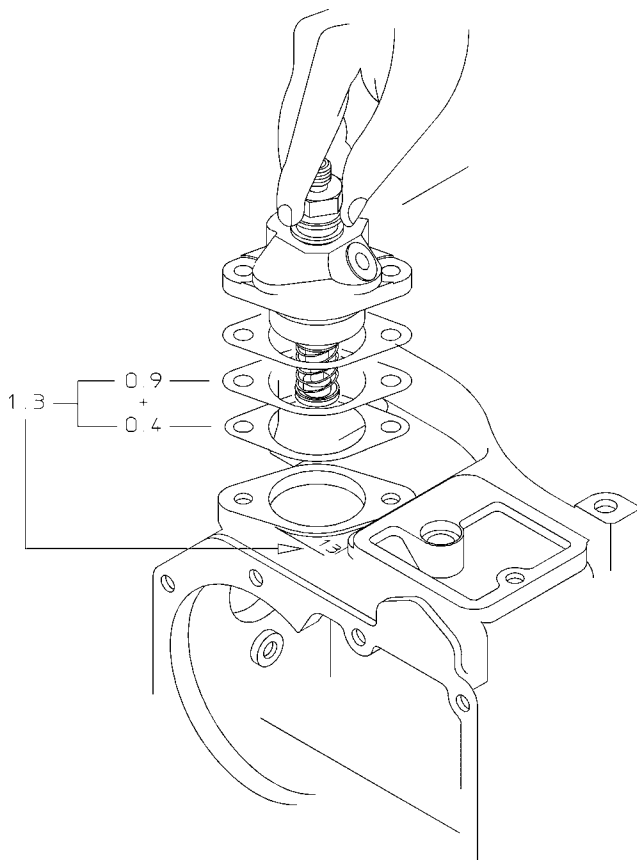


Attention:

Assembly position for the nozzle:
overflow oil line towards the
valve cover.



Injection System



ATTENTION

Injection Pump:

- Defined seals are always used when fitting the injection pump.
- The total thickness of the pump shims is imprinted on the surface of the crankcase, next to the injection pump.
- It is absolutely essential to keep this seal thickness when the injection pump is exchanged.
- If the rated RPMs / engine output are modified, the seal thickness must be corrected in order to set the new injection timing as required (see Chapter 4).

Assembly:

- Move the acceleration lever to the “full load” position. Rotate the flywheel until the pump roller tappet is in the BDC position.
- Move the pin on the injection pump regulating lug into the “full quantity” position.
- Put on the requisite pump shims. When doing this, always place the paper seal on the crankcase surface. Always exchange damaged seals.
- Introduce the injection pump **without** any mechanical resistance.
- The pin on the regulating lug engages in the slot on the transverse lever of the control rod assembly.

To check correct assembly:

- Visual inspection through flanged bearing front cover.
- Turn the engine over using the crank handle; when the acceleration lever is moved from ‘full load’ to ‘stop’, the engine must no longer inject.
- When fitting, always tighten the securing nuts alternately.



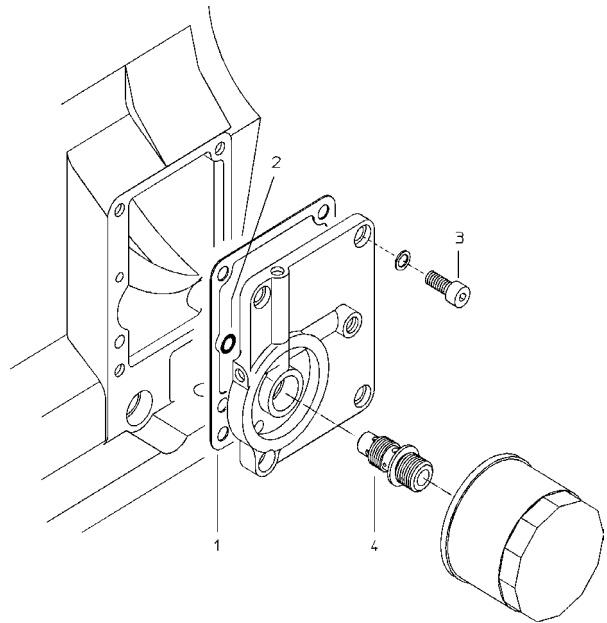
5.6 Oil Filter, Oil Filter Cover, Oil pressure relief valve



ATTENTION

Assembly:

- Generally renew the seal (1) and the O-ring seal (2).
- Before fitting the cover, secure the O-ring seal by greasing it so that it sticks.
- Secure the oil filter cover fitting screws (3) with "Loctite 573" (A) sealing agent, and tighten them alternately and equally. (List of Torques).
- Wet the packing rubber of the oil filter with oil, and hand-tighten without using a tool.



Oil pressure relief valve:

The oil pressure relief valve (4) is calibrated by the manufacturer and therefore it can only be changed completely - no repair is possible.

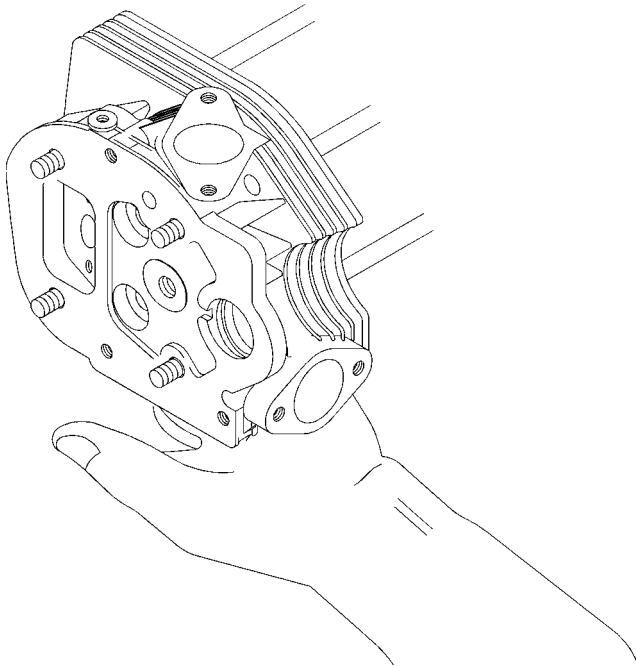
Control of operation: The spring loaded sleeve must be easy moveable.



The oil pressure control sleeve:

- Ball design (engine type 43E)
- Plunger design (engine type 43F)

5.7 Cylinder Head 37E / 43E



Assembly:

- Generally use a new cylinder head seal.
- Use grease to fix the cylinder head seal in the head slot.



ATTENTION

Check the valves for:

- wear and tear on the valve guides
- the condition of the stem seals
- leakproofness and deposits



When tightening the securing nuts, lift the cylinder head slightly and align it radially. (Table of Torques).

5.8 Piston, Cylinder

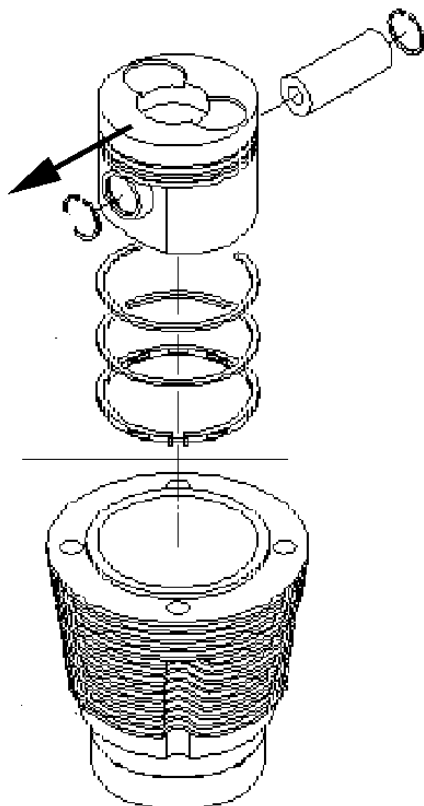
- If the unit shows any traces of corrosion or cracks, the piston and the cylinder must be exchanged.



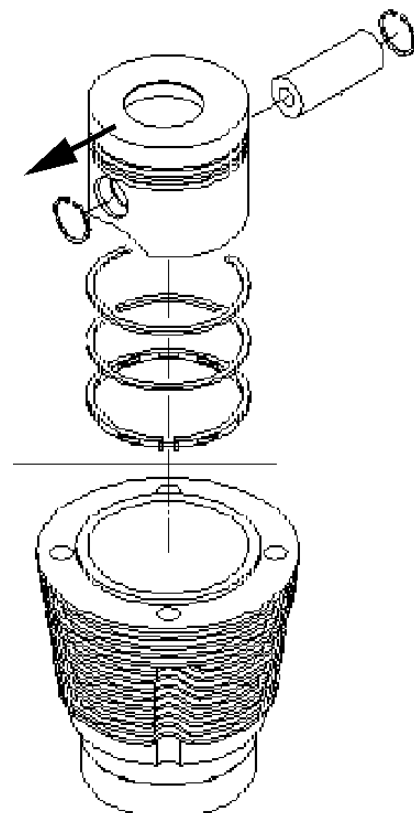
See the Table for wear measurements on the individual components.

- If the limit values are exceeded: exchange the components.
- Oversized pistons / cylinders are not available.

Piston / Cylinder Assy 37E / 43E



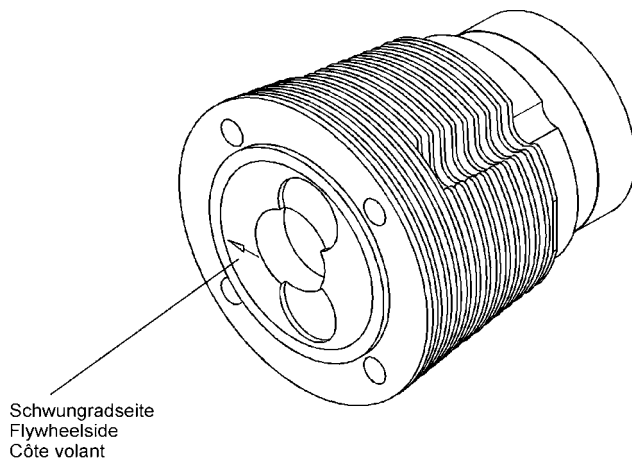
Piston / Cylinder Assy 43F



Index-arrow points to flywheel side.
Combustion chambers out of center !

Attention
Don't mix up 43E / 43F pistons !
Valves will hit the piston head !

5.8.1 Piston, Cylinder assembly



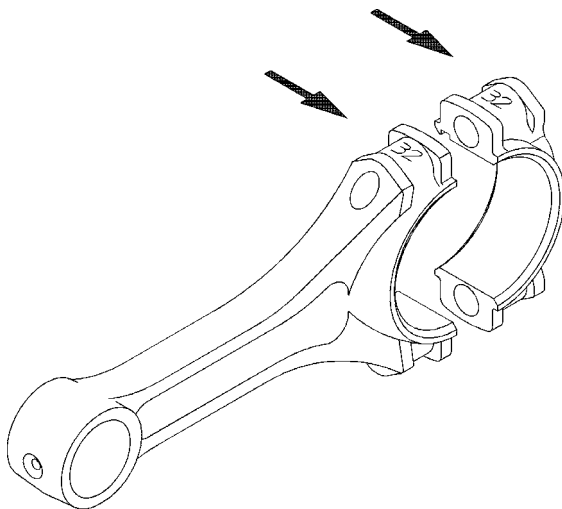
- It is absolutely essential to use a piston retaining strap for the assembly.



There is a marking on the side of the piston which points towards the side of the flywheel.
Original 37E / 43E pistons always have valve pockets. The 43F does not have any.

- Oil the piston, push it into the cylinder and assemble the complete unit.
- Always position the joints with a 120° offset.

5.9 Connecting Rod



- If the wear measurements are exceeded, exchange the bearing shells and/or con rod bearing.



When assembling, the identification numbers on the con rod and the bearing cover must be together.

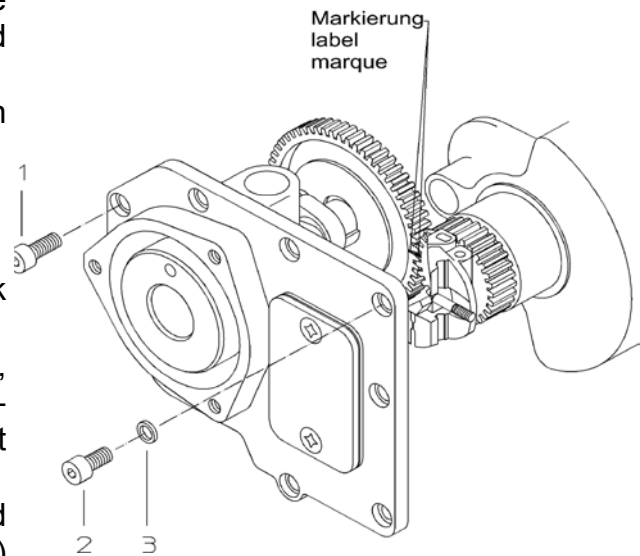
- It is absolutely essential to lubricate the bearings: List of Torques

5.10 Camshaft with Automatic Decompression

- The unit comprising the camshaft and the flanged bearing can only be exchanged complete.
- It is not possible to carry out repairs on the decompression unit.

Assembly:

- Position the flywheel on the TDC mark (crankcase / flywheel)
- When the flanged bearing is pushed in, the camshaft gearwheel mark be positioned true to the mark on the crankshaft gearwheel.
- The long securing screws on the flanged bearing are fitted using "Loctite 573" (A) sealing agent.
- Do not use any shims, etc.



Attention:



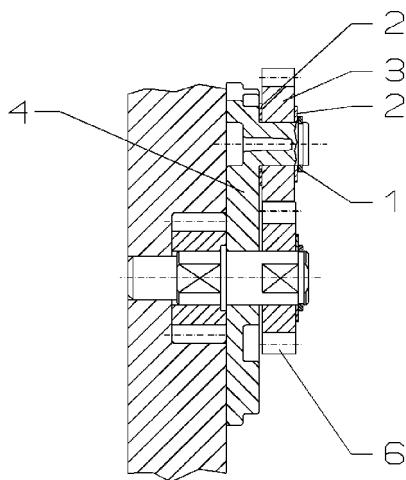
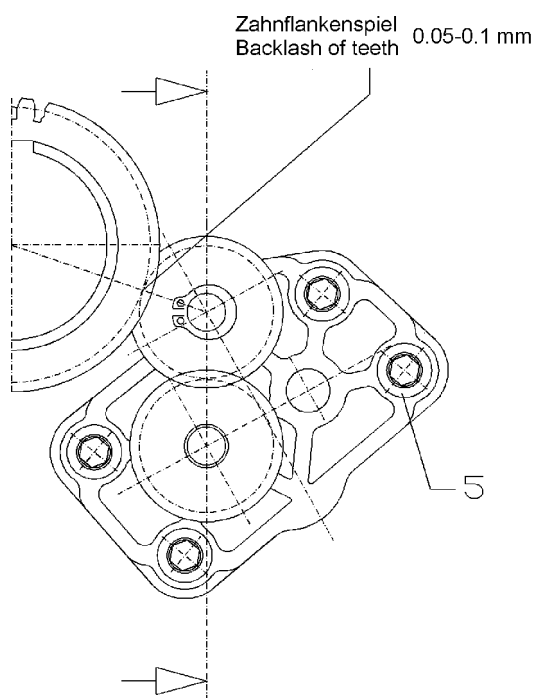
- The top right hand securing screw (2) is shorter.
- Do not use any sealing agent here, but use a copper washer (3) instead.



43F (new series):

- The securing screws are of equal length.

5.11 Lubricating oil pump 37E / 43E



When exchanging the lubricating oil pump, no. E724.036.8 or no. 724.040.8, the assembly must be carried out as follows:

1. Dismantle the intermediate gear wheel (3).
2. CAUTION: Remember the shims for end float.
3. Remove the locking ring (1), washers (2) and intermediate gear wheel (3) from the lubricating oil pump.
4. Lubricate the pump chamber in the crankcase, and the lubricating oil pump itself.
5. Insert the lubricating oil pump into the pump chamber and secure the pump cover (4) with socket head cap screws (5); when doing this, only tighten the socket head cap screws (5) slightly - it must be possible to turn the toothed driving wheel (6) without resistance.
6. Tighten the socket head cap screws (5) equally, with torque = 10 Nm; it must still be possible to turn the toothed driving wheel (6) without resistance.
7. Fit the intermediate gear wheel (3), washers (2) and locking ring (1).
8. Check the gear backlash between the intermediate gear wheel (3) and the crankshaft gear wheel.
This must be between 0,05 and 0,1 mm.



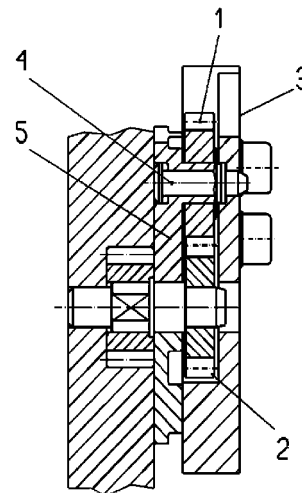
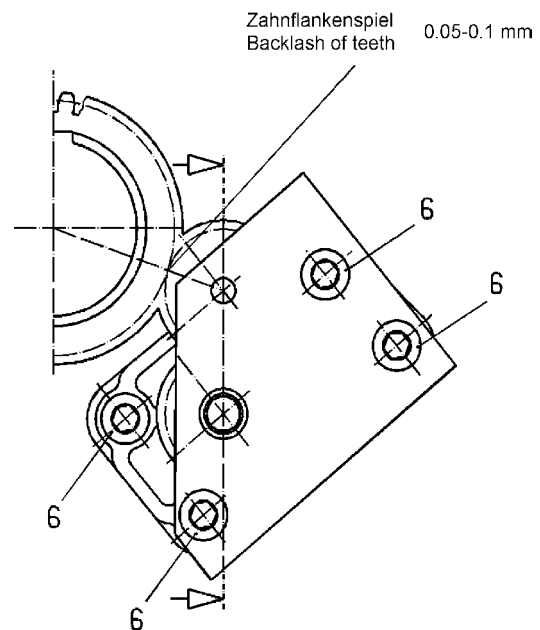
Pumps must not be operated if the gearing jams.

5.12 Lubricating oil pump 43E, conversion kit

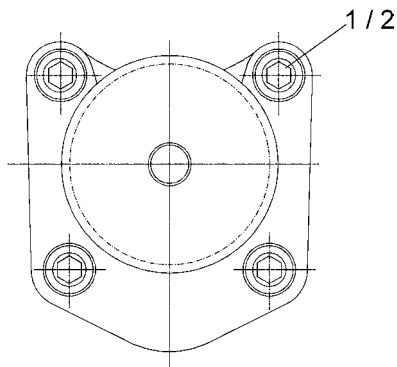
The teeth of gearwheels (1) and (2) may experience premature wear if the engines are used under difficult operating conditions. For this reason, the gearwheel (1) mounted on one side with support bracket (3) has been additionally supported by a pin (4).

Proceed as follows when assembling the lubricating oil pump:

1. Lubricate the pump chamber in the crankcase, and the lubricating oil pump itself.
2. Apply SILOMAT liquid sealing agent on pump cover (5) in the area of the sealing surface.
3. Insert the lubrication oil pump into the pump chamber, and secure the pump cover (5) with the support bracket (3), using socket head cap screws (6). Only tighten the socket head cap screws (6) slightly.
4. Completely crank the engine once from the flywheel, tighten the socket head cap screws evenly (6) to torque = 10 Nm.
5. Check gear backlash between gearwheel (1) and crankshaft gearwheel. This must be between 0.05 and 0.1 mm.



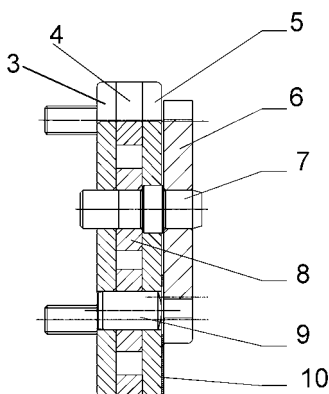
5.13 Lubricating Oil Pump 43F



For dates of construction from 6/1996 onwards, this pump is also used for 37E and 43E engines.

When exchanging lubricating oil pump no. E724.038.8, the assembly must be carried out as follows:

1. Unscrew four screws, M6 x 25 (1+2) and take out the complete oil pump.
2. The pump is supplied pre-assembled,
3. Fit the complete oil pump into the control casing. The protruding part of the oil pump shaft is received by the index bore. If the assembly is correct, the oil pump will (7) lie against the rear wall of the control housing without a gap. Ensure that the joint surfaces are clean.
4. Position screws, M6 x 25 (1) with spring lock washers (2) and tighten to 10 Nm torque.
5. Function controll:
Check the gear backlash between the oil pump and the crankshaft gear wheel. It must be at least 0,05 mm. This will be guaranteed if rotary play can be seen and felt in the tooth contact engagement. The test have to be done on four points (4x90°) of the gear wheel (6).



ATTENTION

- 1 Screw, M6 x 25
- 2 Spring lock washer
- 3 Cover
- 4 Housing
- 5 Cover
- 6 Gear wheel, $Z=24 / m=1.75$
- 7 Pump shaft
- 8 Gear wheel, $Z=07 / m=3.0$ (2x)
- 9 Bolt (3x)
- 10 Locking plate

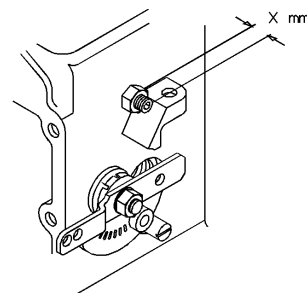
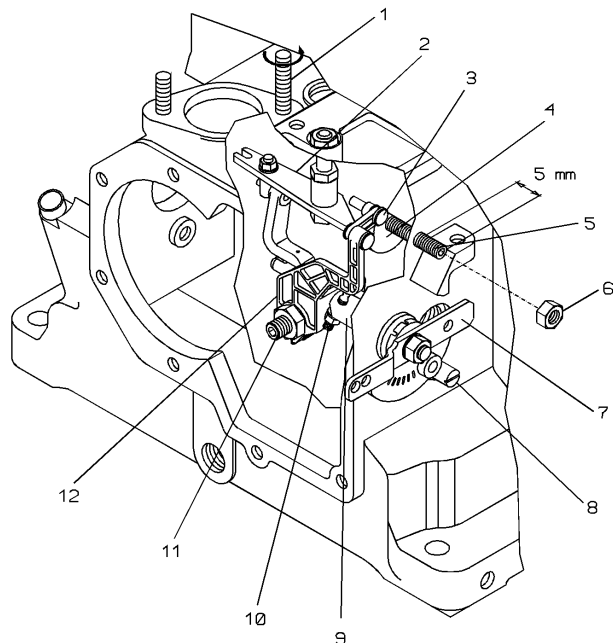
5.14 Regulation Mechanism

Preliminary Work:

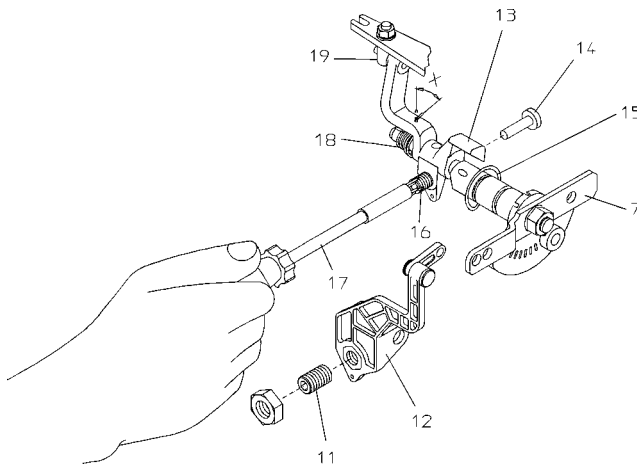
- Dismantle the injection pump.
- Dismantle the flanged bearing with the camshaft.
- On the injection pump flange, unscrew the rear stay bolt (1) until the transverse lever (2) is released.
- Remove the stop buffer screw (10) on the eccentric shaft (9) and the external eccentric screw (8).

Dismantling:

- Determine and note the position of the setscrew (5).
- Remove the locking nut (6) and screw the setscrew in until the flange bolt (3) on the automatic starting enrichment lever (12) (automatic increased starting quantity - ASM) disengages from the segment (4).
- Screw the setscrew back until it protrudes about 5 mm in relation to the surface of the crankcase.
- Unhook the spring on the ASM lever (12) and remove the setscrew (11).
- Loosen the threaded bushing (16), special tool (17), by about 3 revolutions.
- Remove the annular spring from the eccentric shaft and remove the eccentric shaft, rotating it in the direction of 'stop'.
- Dismantle the complete set of levers.



5.15 Regulation Mechanism



Assembly:

ATTENTION: Insert the governor needle, and secure it with grease. Pre-assemble the eccentric shaft (9) with the requisite parts.

ATTENTION: For stationary regulation, the torsion spring can be clamped to the rest plate in order to make assembly easier.

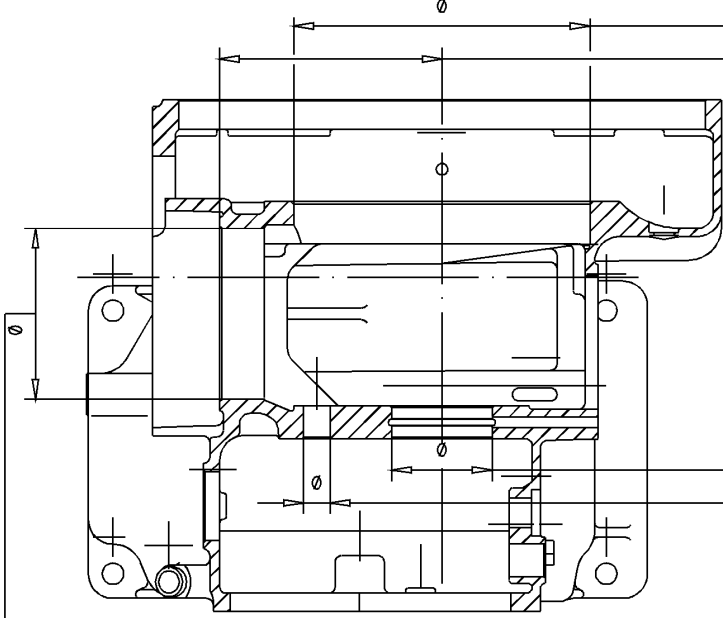
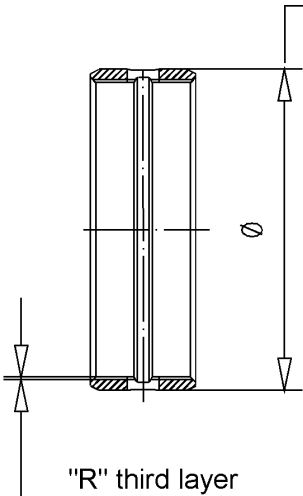
- Insert the leg of the return spring (18) into the regulating lever (13) and bend it about 5 mm to 75° (x).
- Use the special tool (17) to screw the threaded bushing (16) into the regulating lever.
- The thread must be flush with the rear side of the lever.
- Push the flange bolt (14) into the threaded bushing in the regulating lever.
- Place the automatic increased starting quantity lever (12) - without the setscrew (11) - over the regulating lever.
- Introduce the eccentric shaft into the lubricated bearing bush. When doing this, set the acceleration lever (7) approximately to the stop position.
- Push the set of levers (12 + 13) on to the eccentric shaft.
- The return spring must fit into the eccentric shaft slot without resistance.
- At the same time as this operation, turn the acceleration lever in the direction of “full load”.
- Rotate the eccentric shaft while pulling it out of the bearing bush, and press the transverse lever (2) in the direction of the crankcase wall until the pin engages in the forked bolt (19) of the transverse lever.
- Move the eccentric shaft back into the bearing bush, and secure it with the annular spring (15).
- Screw in the external eccentric stop screw (8) to fix the regulating lever.

Function Check:

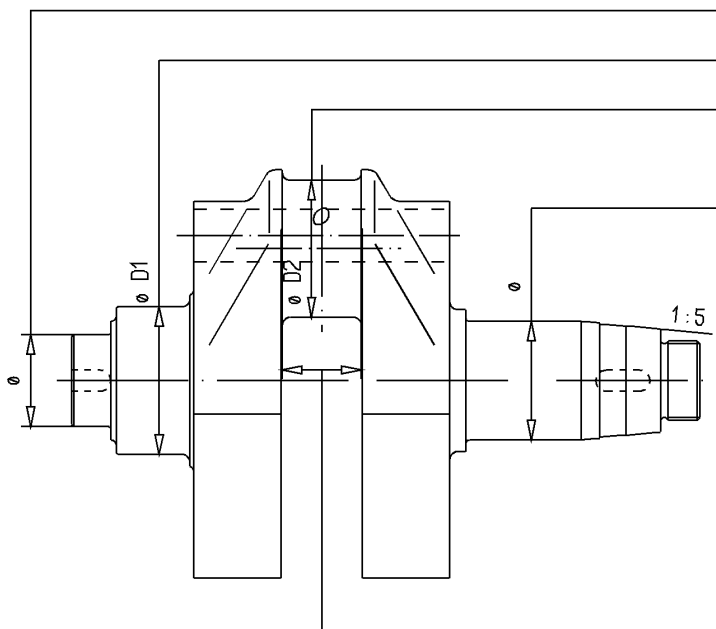
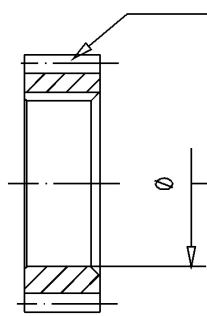
- Move the acceleration lever (7) into the ‘full load’ position.
- The regulating lever (13) must press AGAINST the governor via the return spring.
- Move the flanged bolt (3) on the automatic increased starting quantity lever into the bore on the segment (4) by adjusting the setscrew (5).
- Move the setscrew (5) and the locking nut into the previously determined positions, and lock them.
- Screw in the stay bolt on the injection pump flange; assemble the flanged bearing with the camshaft.

MEASUREMENT TABLES, WEARING PARTS

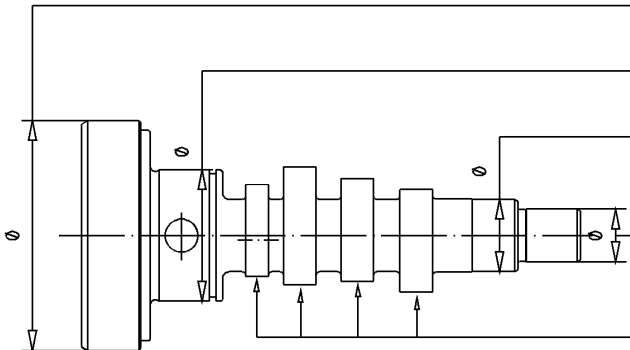
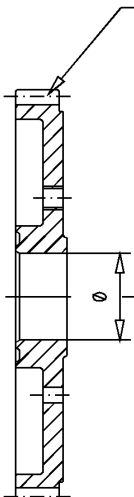
6. Measurement Tables - Wearing Parts

Part. Description	Dimension		
	Original max. mm	min. mm	max. Limit mm
Crankcase 37E, 43E, 43F 	180.025 135.325	180.000 135.300	135.250
	61.019 16.018	61.000 16.000	61.035 16.070
	104.035	104.000	
Main bushing 37E, 43E, 43F 	61.105	61.068	
	0.070	0.030	0.100
	inner diameter not fixed can only be checked when bush is pressed into crankcase via the bearing play, radial play: Bearing bush will have to be replaced when galvanically applied Layer "R" wears off (recognisable on shiny gold bronze color) and / or when scoring appears around circumference. The inner diameter should not be used to determinate wear, only the radial bearing play is important.		

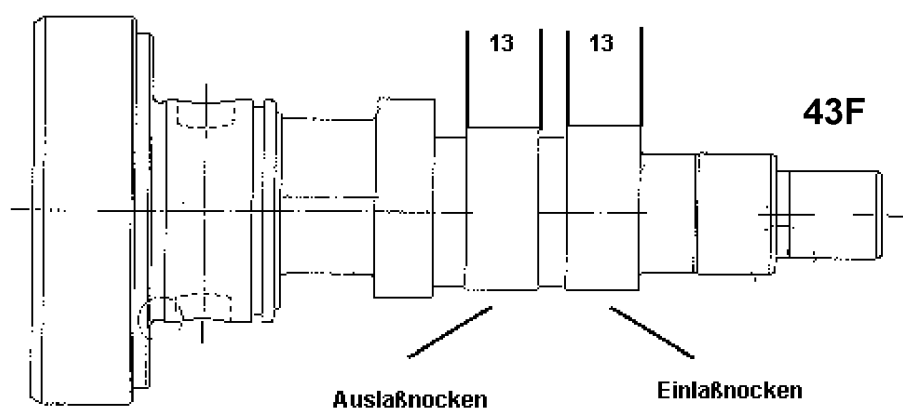
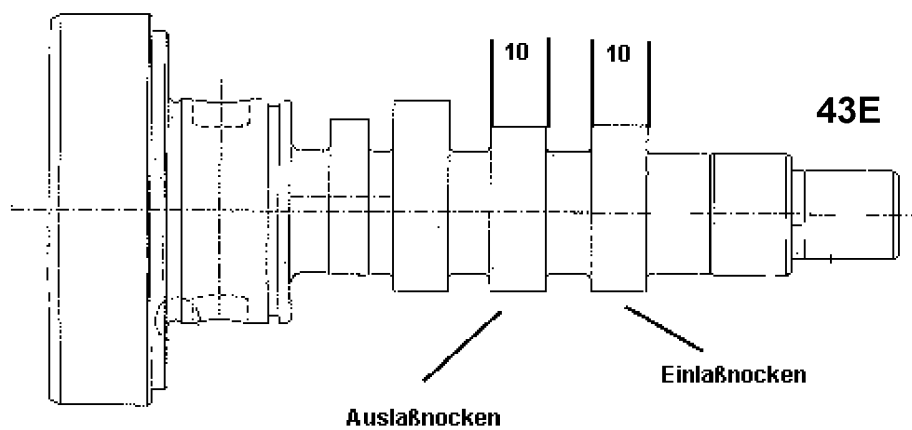
MEASUREMENT TABLES, WEARING PARTS

Part. Description	Dimension																						
	max. mm	Original min. mm	max. Limit mm																				
Crankshaft 37E, 43E, 43F  Radial Bearing play D1 _____ D2 _____ Regrind Stages The crank pin and journal can be reground in 2 steps of 0.25 mm each and fitted with under size bearings <table><tr><th></th><th>ØD1</th><th>ØD2</th><th colspan="2">corresponding bearing</th></tr><tr><th></th><th></th><th></th><th>D1</th><th>D2</th></tr><tr><td>1</td><td>55.760 55.740</td><td>51.710 51.690</td><td>775.039.4</td><td>470.023.4</td></tr><tr><td>2</td><td>55.510 55.490</td><td>51.460 51.440</td><td>775.040.4</td><td>470.024.4</td></tr></table>		ØD1	ØD2	corresponding bearing					D1	D2	1	55.760 55.740	51.710 51.690	775.039.4	470.023.4	2	55.510 55.490	51.460 51.440	775.040.4	470.024.4	35.018 56.010 51.960 45.020 30.250 0.070 0.070	35.002 55.990 51.940 45.009 30.198 0.030 0.030	* * * * allowable wear to be determined by radial bearing play 30.350 0.100 0.130
	ØD1	ØD2	corresponding bearing																				
			D1	D2																			
1	55.760 55.740	51.710 51.690	775.039.4	470.023.4																			
2	55.510 55.490	51.460 51.440	775.040.4	470.024.4																			
Gearwheel Crankshaft 37E, 43E, 43F 	34.985	34.965	Tooth edges smooth, no scoring and wear. Heat gear to 90-100°C to obtain shrink-fit.																				

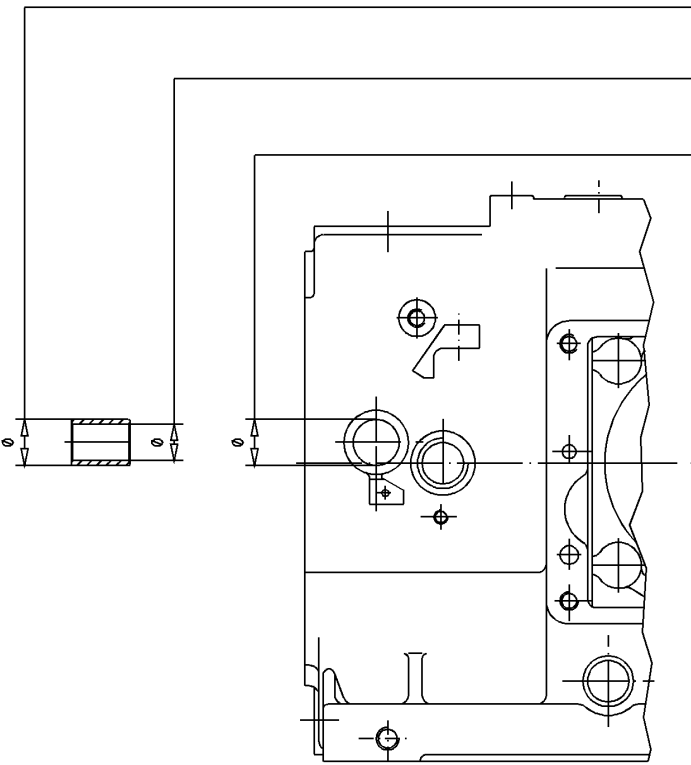
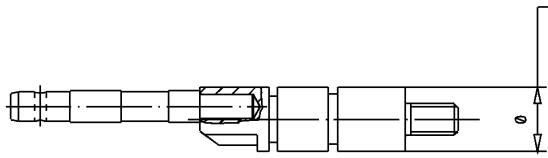
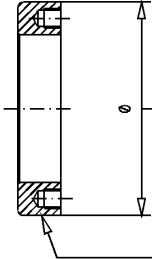
MEASUREMENT TABLES, WEARING PARTS

Part. Description	Dimension		
	max. mm	Original min. mm	max. Limit mm
Camshaft 37E, 43E, 43F 	70.000	69.954	69.904
	40.018	40.002	
	22.048	22.035	
	15.930	15.910	15.860
			renew if scored
Gearwheel Camshaft 37E, 43E, 43F 			Tooth edges smooth, no scoring and wear.
	21.989	21.976	
	Heat gear to 90-100°C to obtain shrink-fit.		

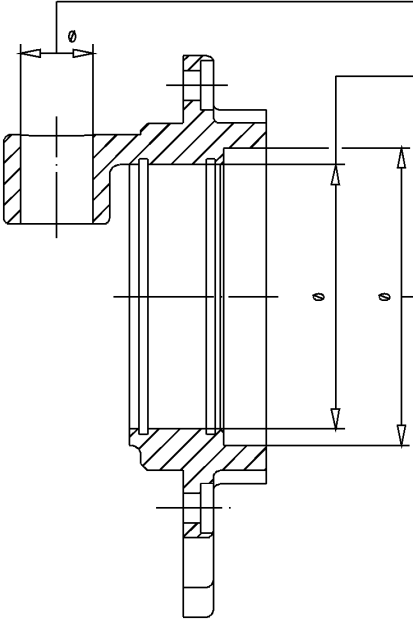
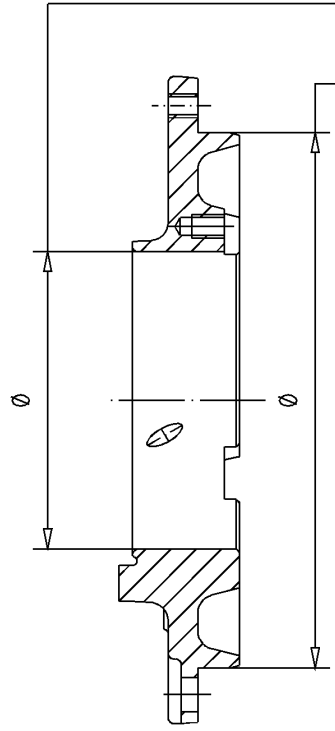
Comparison of 43E / 43F - Camshafts



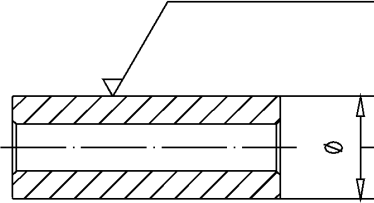
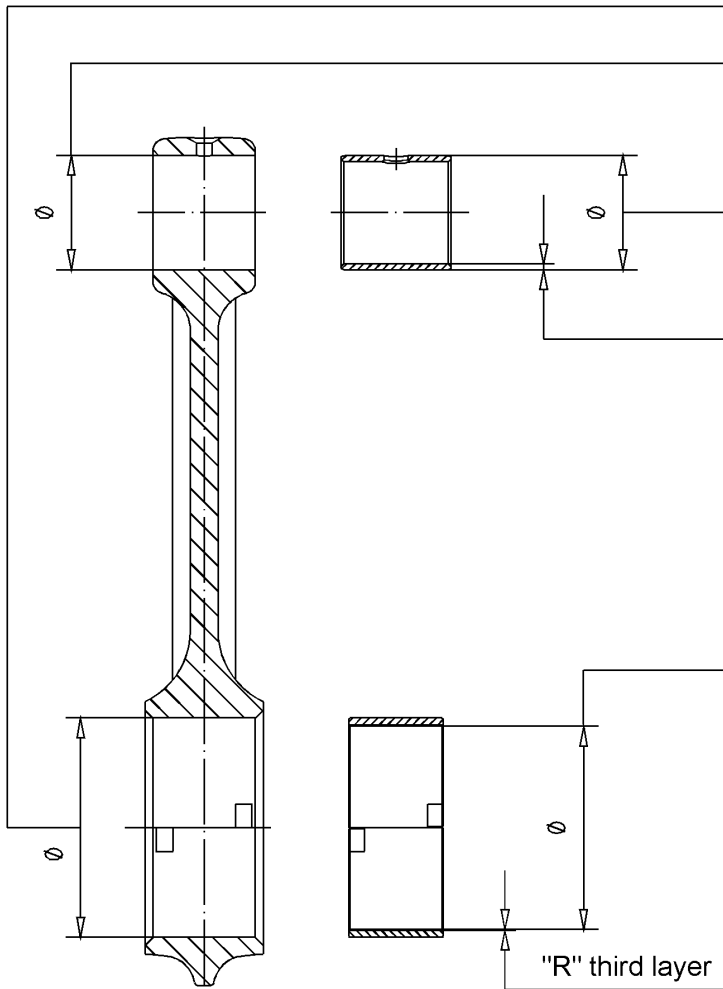
MEASUREMENT TABLES, WEARING PARTS

Part. Description	Dimension		
	Original max. mm	min. mm	max. Limit mm
Crankcase 37E, 43E, 43F 	20.074	20.054	16.145
	16.110	16.090	
	16.095	16.075	
	20.021	20.000	
Excentric Shaft 37E, 43E, 43F 	16.020	16.012	16.000
Angle Ring 37E, 43E, 43F 	65.000	64.810	renew if scored

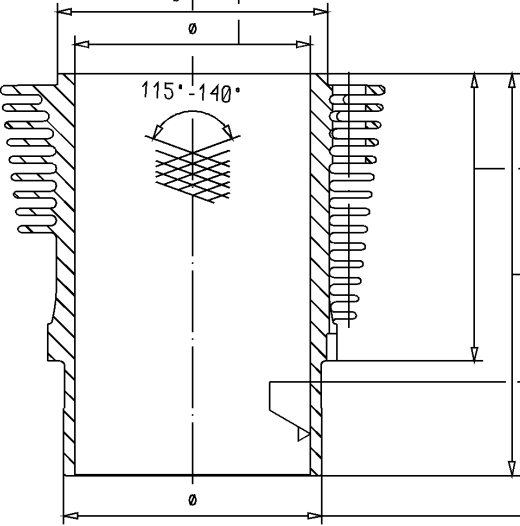
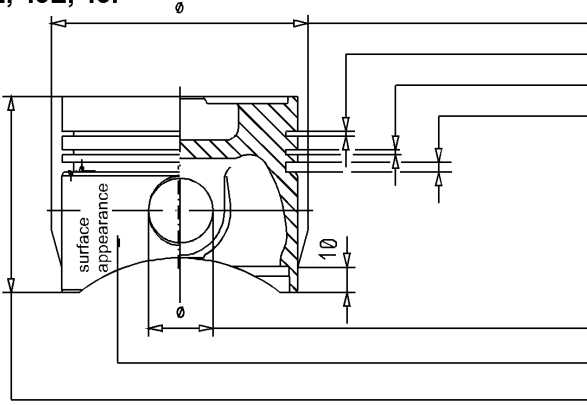
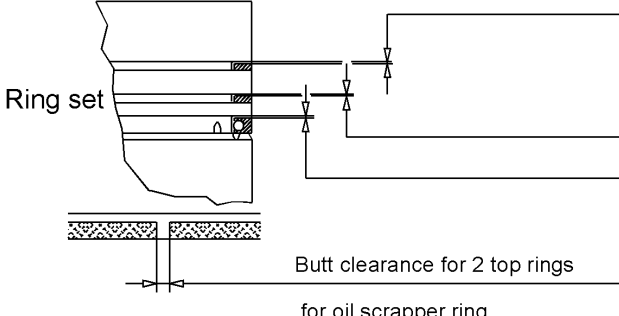
MEASUREMENT TABLES, WEARING PARTS

Part. Description	Dimension		
	max. mm	Original min. mm	max. Limit mm
Flange Bearing 37E, 43E, 43F 	22.021	22.000	22.080
	79.991	79.961	
	90.054	90.000	
Main Bearing Flange 37E, 43E, 43F 	99.956	99.934	
	180.068	180.043	180.040

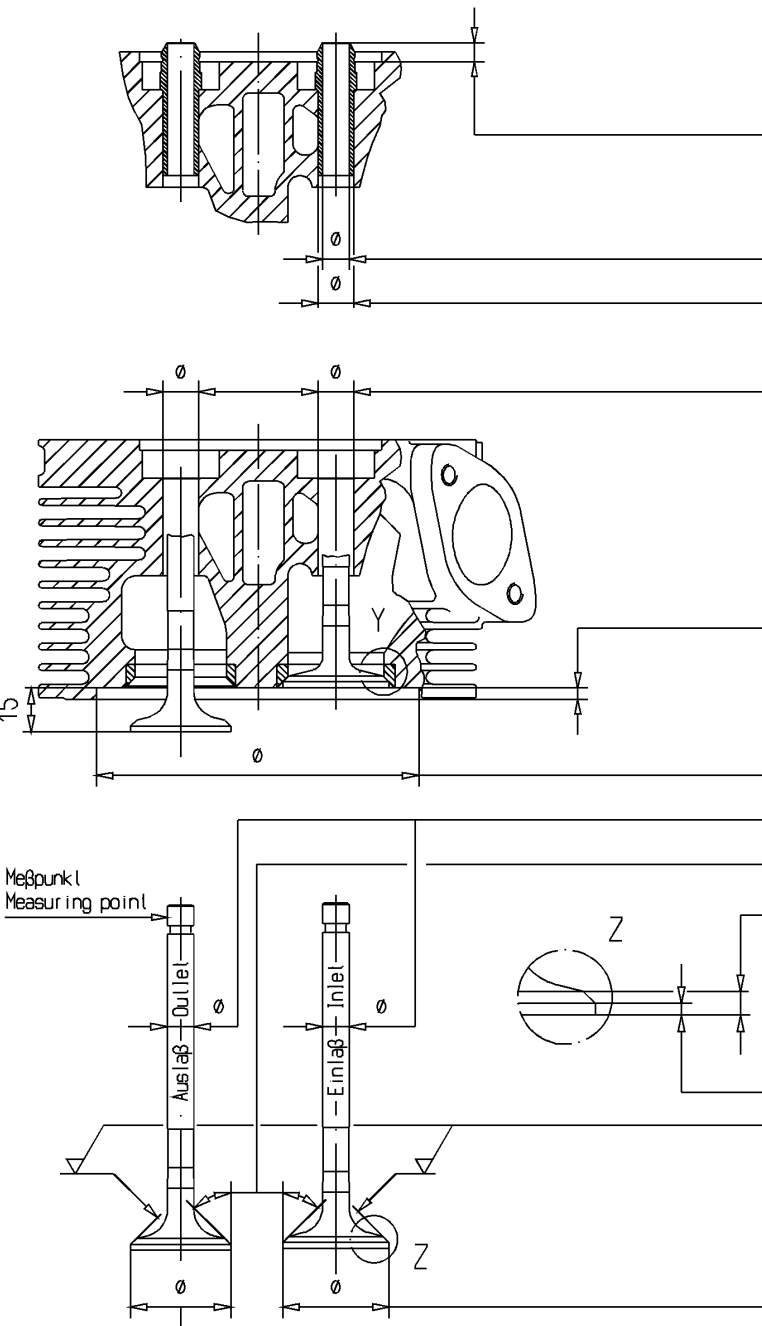
MEASUREMENT TABLES, WEARING PARTS

Part. Description	Dimension		
	max. mm	Original min. mm	max. Limit mm
Piston Pin 37E, 43E, 43F 	26.000	26.996	renew if scored
Connecting Rod with Bearings 37E, 43E, 43F 	55.619	55.600	inner diameter only to be checked via radial bearing play: 0.070 0.030 0.130 Both bearing shells will have to be renewed when the galvanically applied layer "R" wears off (recognisable on shiny gold-bronze color) and / or when scoring appears around circumference.
	29.013	29.000	
	29.075	29.035	
	1.495	1.483	

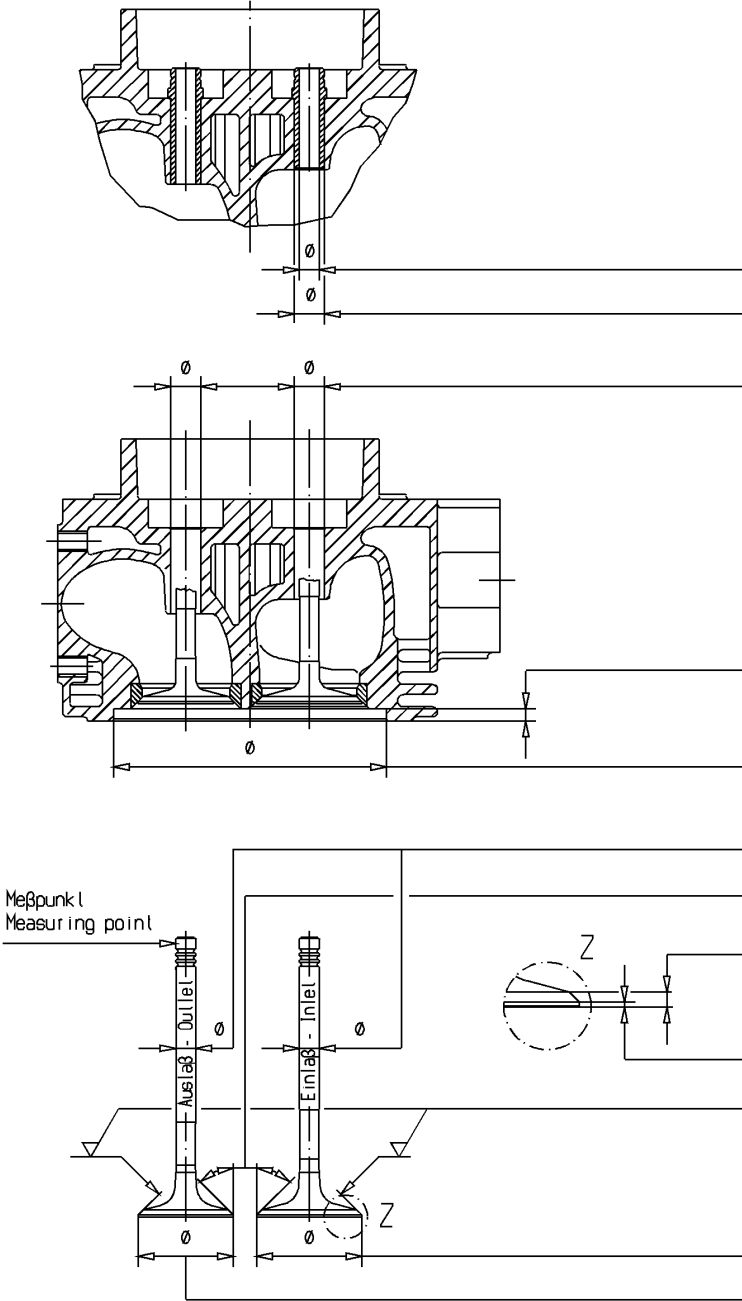
MEASUREMENT TABLES, WEARING PARTS

Part. Description	Dimension		
	max. Original mm	min. mm	max. Limit mm
Cylinder 37E, 43E, 43F 	108.995 95.006	108.990 95.004	95.016
	115.940	115.900	115.850
	162.500	161.500	
	103.880	103.793	renew if scored
Piston 37E, 43E, 43F  	95.127 2.012 2.006 4.006	95.113 2.010 2.004 4.004	
	79.350	78.650	renew if longitudinally scored
	0.037	0.020	
	0.031	0.014	
	0.031	0.014	
	0.650	0.400	1.100
	0.600	0.300	1.100
	Butt clearance for 2 top rings for oil scraper ring		
	Butt clearance are caused by piston ring wear and wear of cylinder liner surface. We recommend always to exchange cylinder liner, piston and rings together.		

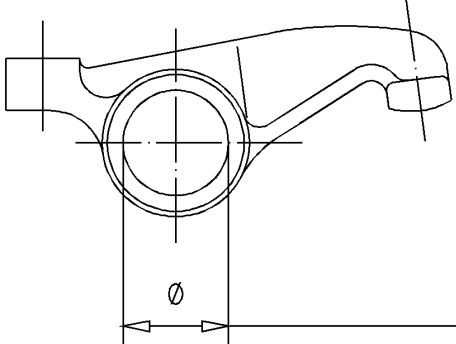
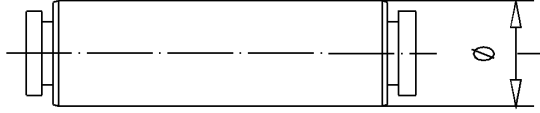
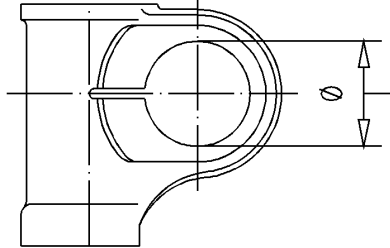
MEASUREMENT TABLES, WEARING PARTS

Part. Description	Dimension		
	Original max. mm	min. mm	max. Limit mm
Cylinderhead 37E, 43E  press guide in till lower edge is flush with wall inside channels see note renew if scored Note: To check wear of valve shaft and valve guide, insert valve guide and put dial gauge to "measuring point". Move valve lateral. If movement is more than 0.15 mm replace both parts.	5.800	5.000	see note
	9.009	9.000	
	12.030	12.012	
	11.980	11.969	see note
	4.100	3.900	
	109.200	109.150	
	8.930	8.918	renew if scored
	45°		
	4.200	3.800	
	2.000	1.850	renew if scored
	36.300	35.700	
	34.300	33.700	

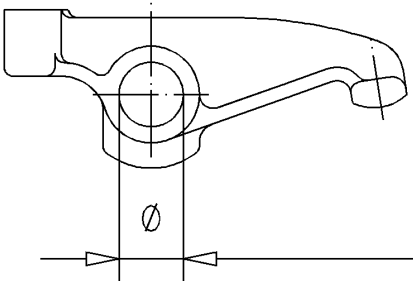
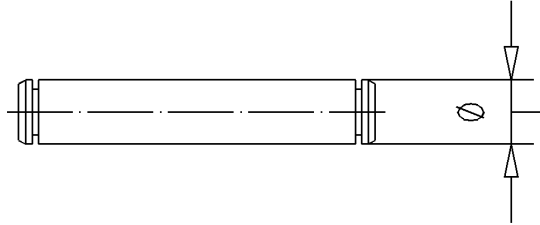
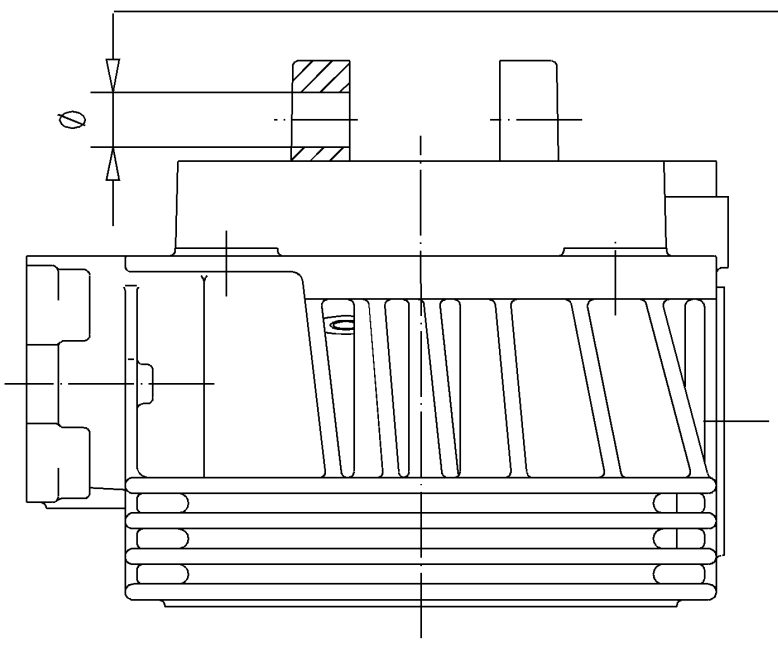
MEASUREMENT TABLES, WEARING PARTS

Part. Description	Dimension		
	max. mm	Original min. mm	max. Limit mm
Cylinderhead 43F  Note: To check wear of valve shaft and valve guide, insert valve guide and put dial gauge to "measuring point". Move valve lateral. If movement is more than 0.15 mm replace both parts.	8.015	8.000	see note
	12.030	12.012	
	11.985	11.974	
	5.100	5.000	see note
	109.200	109.150	
	7.930	7.918	
	44°40'	45°	renew if scored
	3.200	2.800	
	1.000	0.860	
	42.150	41.850	
	38.150	41.850	

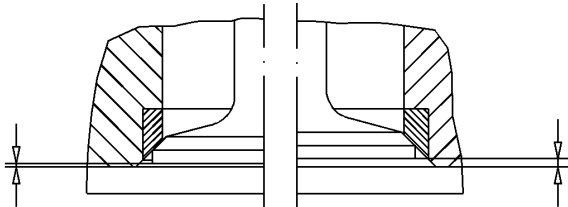
MEASUREMENT TABLES, WEARING PARTS

Part. Description	Dimension		
	max. mm	Original min. mm	max. Limit mm
Rocker arm 37E, 43E 	20.021	20.000	20.060
Rocker shaft 37E, 43E 	19.980	19.959	19.950
Rocker arm assy 37E, 43E 	19.996	19.994	

MEASUREMENT TABLES, WEARING PARTS

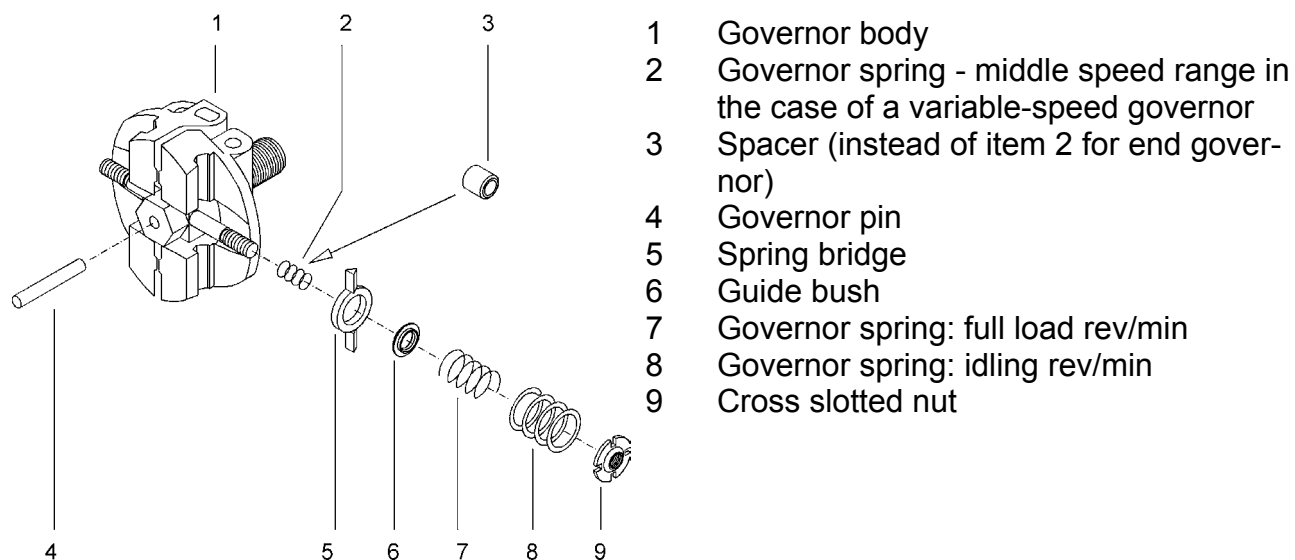
Part. Description	Dimension		
	max. mm	Original min. mm	max. Limit mm
Rocker arm 43F 	14.011	14.000	14.050
Rocker shaft 43F 	13.984	13.966	13.955
Cylinderhead 43F 	14.018	14.000	14.060

MEASUREMENT TABLES, WEARING PARTS

Part. Description		Dimension		
		Original max. mm	min. mm	max. Limit mm
Valve protrude and valve in recess 37E, 43E, 43F				
 Auslaß - Outlet Einlaß - Inlet				
		37E	43E	43F
Inlet	protrude			
	in recess	0-0.1	0-0.1	2.5-2.6
Outlet	protrude			
	in recess	0-0.1	0-0.1	2.5-2.6

7. Special Components

7.1.1 Centrifugal Speed Governor



7.2 Crankshaft, Flywheel



ATTENTION



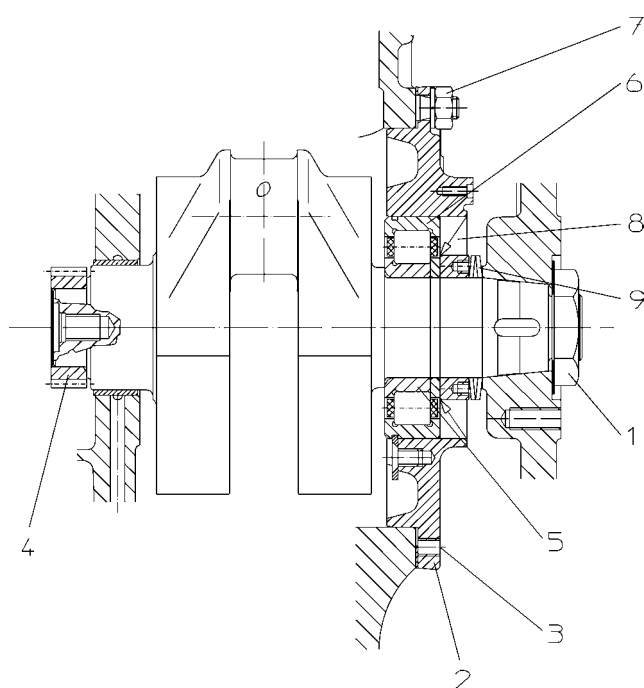
CAUTION

- If the flywheel is removed from the complete engine, the acceleration lever must previously be set to 'full load'.

Dismantling:

- Use the drive wrench (special tool 748.128.4 and 748.154.2) to loosen the flywheel nut. Do not screw off.
- Loosen the flywheel from its seat with the puller, 748.122.6; remove it.
- Loosen the bearing cover from the slot with pulling screws M8 x 40.
- The crankshaft gear wheel and the inside bearing washer can be loosened using the pull-off device, 748.137.2 and 748.132.6.
- **Attention!** Lubrication oil pump has to be taken off before dismantling the bearing plate

Assembly:



- The inside bearing washer and the crankshaft gear wheel are mounted hot. (4) + (5)
- The inside bearing washer and the cylindrical roller bearing are always paired.
- Gently hammer the bearing cover (2) to achieve a snug fit in the seat (PVC hammer), and then use the securing nuts (7) to tighten on alternate sides.
- Generally renew the shaft seal (8).
- Assemble the fitting parts and the flywheel according to the sequence (see drawing).
- Mounting of lubrication oil pump.
- The fitting surfaces must be free of grease and dirt.
- Please note the position of the disk springs (9).
- Tighten the flywheel using a torque wrench or a drive wrench (see Table of Torques).



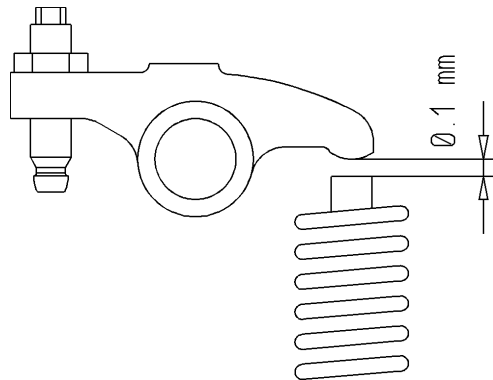
CAUTION

8. Adjustments, Settings

8.1 Valve Setting

The valve clearance for both valves is 0.1 mm (cold). The valve clearance must be checked for the first time after 20 operating hours and thereafter every 300 operating hours and, if necessary, is to be adjusted as follows: The clearance is to be set with the engine cold, at the end of the compression stroke with both valves closed.

Remove the valve cover. Rotate the flywheel until the mark is vertical and right-hand. Adjust the valves and refit the valve cover.



CAUTION

- To prevent unintentional starting, the high-pressure line must always be detached at the fuel injection pump.
- Fuel which leaks at high pressure at the threaded joint may cause severe injuries.

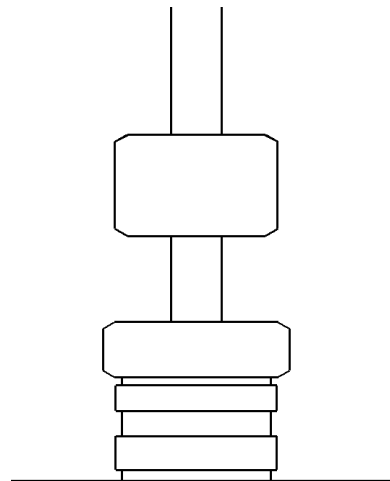


ATTENTION

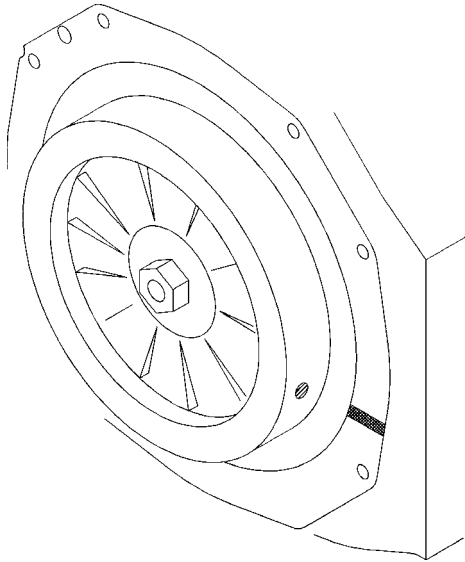
To prevent leaks, the valve cover seal is to be replaced at every adjustment.



The adjustment is to be carried out when the engine is cold.



8.1.1 Valve setting procedure



Exhaust valve:

- Turn crankshaft slowly with the starting handle until the end of the compression stroke.

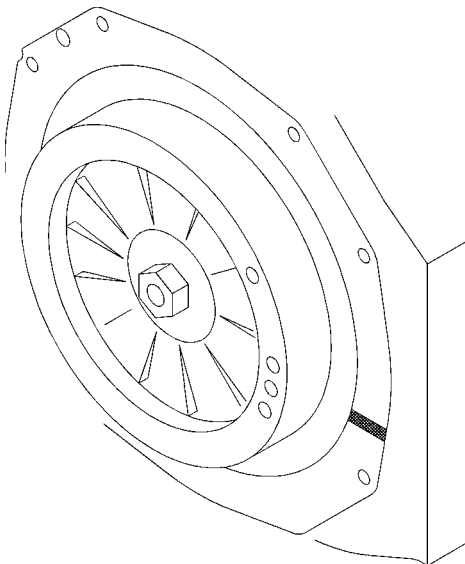


In this position the exhaust valve is closed (max. clearance between rocker and valve) and the top dead centre mark of the flywheel points to the mark on the crankcase.

- Check clearance between exhaust valve and rocker with a feeler gauge and, if necessary, set to 0.1 mm.



It must be possible to slide the feeler gauge between the valve and rocker without great force.



Inlet valve:

- Turn crankshaft half a revolution from the top dead centre mark in the direction of rotation.

On engines with a closed flywheel housing you can't see the timing marks (O.T. = T.D.C.).

- Take off rocker cover, turn engine till piston is in O.T. (T.D.C.) position.
- Mark the position on the crank handle support bearing
- Turn engine with starting handle $\frac{1}{4}$ rotation in engine rotation sense.



This makes the automatic decompression ineffective.

Check clearance between intake valve and rocker with a feeler gauge and, if necessary, set to 0.1 mm.



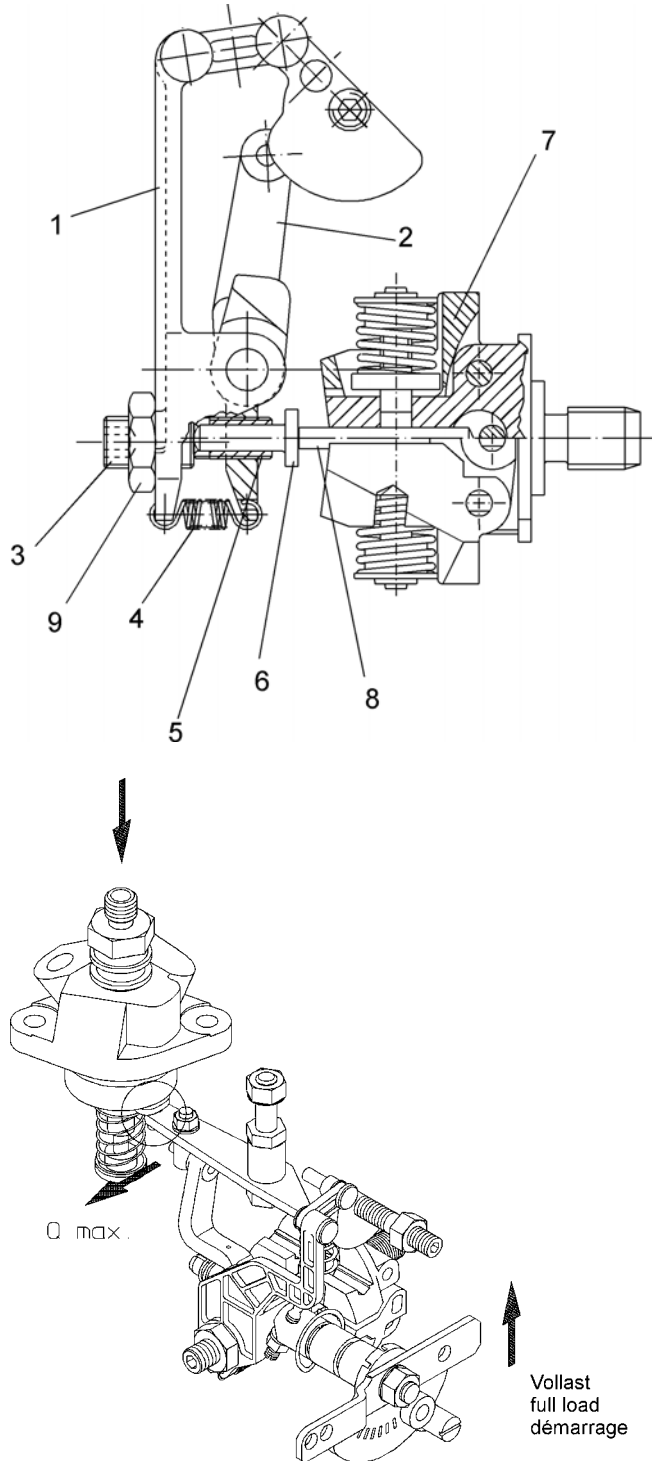
It must be possible to slide the feeler gauge between the valve and rocker without great force.

ADJUSTMENTS, SETTINGS

8.2 Speed Adjustment / Automatic increased Start Quantity

8.2.1 Lever System Setting

- Set the acceleration lever to the "**Full Load**" position.
- Remove the setscrew (3) from the lever (1).
- Carefully unhook the spring (4) from the lever (1).
- Spread the governor weights (7) to the **maximum** extent, using a screw driver.
- Use the tool (17, Illustration 2) to turn the threaded bush (5) until the flanged bolt (6) fits on the governor pin (8) with no play.
- Remove the screw driver and **close** the threaded bush (5) by a further half revolution.
- Carefully hook the spring (4) to the lever (1).



ADJUSTMENTS, SETTINGS

8.2.2 Automatic Enriched Starting Mixture (ESM) Setting

- Set the acceleration lever to the **"Full Load"** position.
- Screw the setscrew (3) into the lever (1) until contact is made with the flanged bolt (6).
- Secure the flanged bolt with the nut (9). (See Illustration 4.1.1)

Attention:

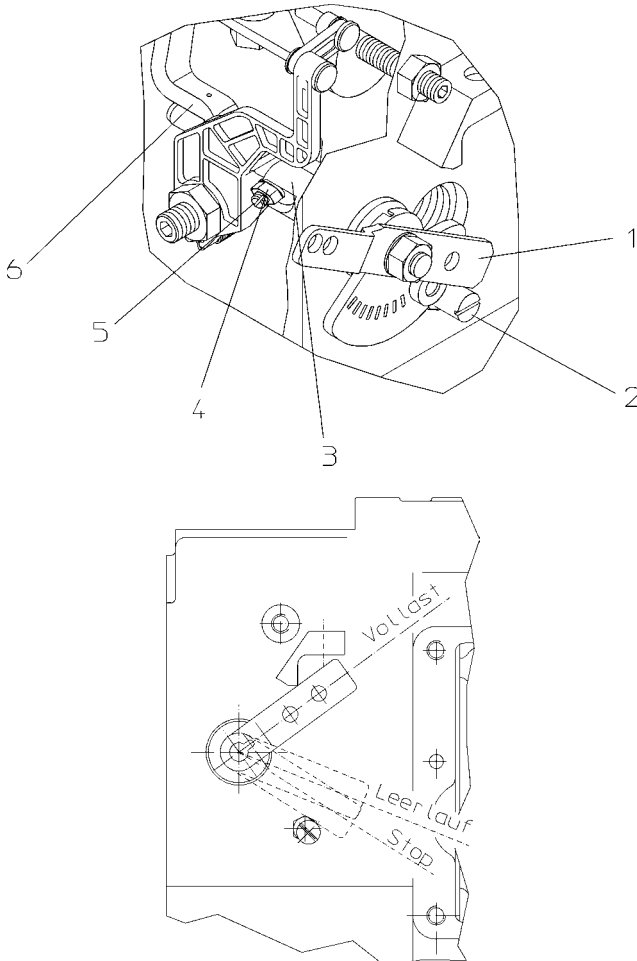
- Divergences in the setting will change the active period for the enriched starting mixture (1)
- Play between the setscrew (3) and the flanged bolt (6) = ESM is active for a longer period after starting, and the engine will smoke.
- Setscrew (3) and flanged bolt(6) are tightened = ESM function is not guaranteed.

Function Test:

- Start the engine from the full load position.
- If the ESM has been set correctly, the starting smoke period will last about 2-3 seconds. This is followed by smoke-free run-up to normal operation.

8.3 End Stop

8.3.1 End Stop Adjustment



- Move the acceleration lever (1) to the **"Stop"** position.
- Loosen the outer end stop eccentric (2) in advance.
- Screw in the stop screw (5) on the eccentric shaft (3) until contact is made with the regulating lever (6).
- Lock the stop screw with the nut (4).
- Turn the outer end stop eccentric (2) against the regulating lever until the latter is lifted about 1 mm from the stop position.
- Lock the eccentric screw.

Attention:



- The outer stop buffer eccentric prevents damage to the regulating rod assembly (critical for building on Bowden pull wires).

ADJUSTMENTS, SETTINGS

8.4 Injection pump - Setting Values - End of Delivery

Engine type	Flywheel		End of delivery (mm) before TDC - Tolerance + - 2mm at engine speed (min ⁻¹)							
	Part Num- ber	Dia- meter mm								
			1500	1800	2000	2500	2800	3000	3300	3600
	738.265.4	310								
	738.293.4		21	24	26	32	35	37	*	*
	738.307.4									
37E	738.266.4	350	24	27	29	36	40	42	*	*
	738.294.4									
	738.268.4	375	26	29	32	39	42	45	*	*
	738.295.4									
	738.265.4	310								
	738.293.4		24	27	29	35	38	40	*	*
	738.307.4									
43E	738.266.4	350	27	31	33	37	43	45	*	*
	738.294.4									
	738.268.4	375	29	33	35	42	46	48	*	*
	738.295.4									
	738.265.4	310								
	738.293.4		*	*	*	34 ¹⁾	36 ¹⁾	39 ¹⁾	*	*
	738.307.4									
43F	738.266.4	350	*	*	*	38 ¹⁾	41 ¹⁾	44 ¹⁾	*	*
	738.294.4									

1) = ±1°

ADJUSTMENTS, SETTINGS

9. Tightening Torques for Screwed Connections

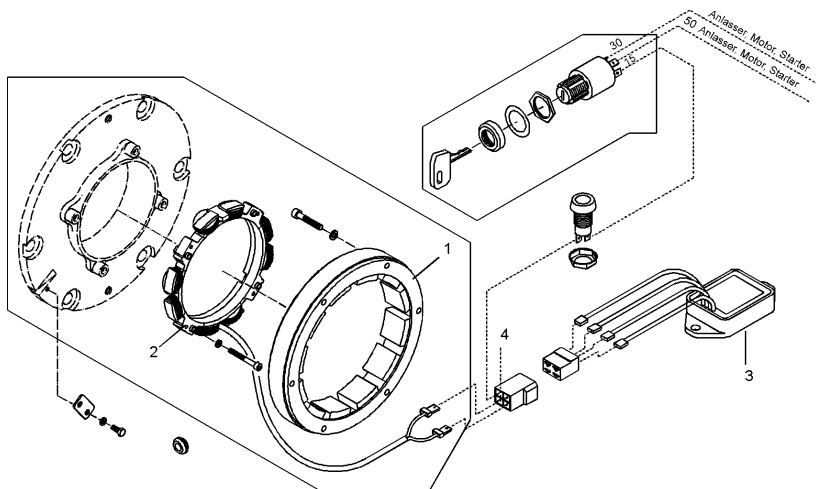
	37E/43E			43F		
	Wrench width (mm)	Tightening Torque (Nm)		Wrench width (mm)	Tightening Torque (Nm)	
		min	max		min	max
Rocker bracket	17	42	46	*	*	*
Cylinder head nuts	17	52	56	15	52	56
Connecting rod nuts	17	58	62	17	58	62
Valve cover nuts	17	44	48	*	*	*
Valve cover bolts	*	*	*	5	16	20
Bearing cover nuts	17	42	46	17	42	46
Injection pump nuts	13	20	23	13	20	23
Injection pump pressure valve bracket	14	34	39	14	34	39
Fuel pressure pipe - union nut - injection pump	17	18	22	17	18	22
Fuel pressure pipe - union nut - nozzle holder	17	25	30	17	25	30
Nuts for nozzle holder fixture	13	20	23	10	10	12
Governor	14	55	60	14	55	60
Flywheel nut	46	390	410	46	390	410
Flanged bearing screws	6	20	23	6	20	23
Tappet guide screws	6	20	23	6	20	23
Foot bearing screws	6	20	23	6	20	23
Lubricating oil pump screws	5	10	12	5	10	12
Hatch cover	6	20	23	6	20	23
Hollow bolt on injection pump	17	25	35	17	25	35
Hollow bolt on nozzle holder	11	8	10	11	8	10
Hollow bolt on tank	12	8	10	12	8	10
Oil filter	Finger-tighten only!					

10. Electrical System

10.1 Flywheel - Dynamo / Governor

Operation:

The permanent magnets in the magnet holder (1) on the fly-wheel side induce an alternating voltage in the coils of the stator (2): this voltage is proportional to speed (RPMs). The alternating voltage is rectified in the governor (3) and continuously regulated to approximately 14.2 - 14.5 V.



Connections to the Governor:

- 2x yellow | Generator coils, input, interchangeable
- 1x red | Output, charging current
- 1x brown | Charge control, Terminal 15, ignition lock

Connection to earth is made via the assembly surface.

Function Tests:

a) Alternating voltage at the coil output

Disconnect the connecting plug (4).

The voltage proportional to speed is measured on the two phases (2x black).

Set values: Graph A, "Idling Voltage without Governor Cut-Out"

b) Coils = single phase to earth

c) Charging current, governor output

Connect a suitable ammeter ($I_{\max}=30A$) into the charging circuit (red cable).

The charging current depends on the speed and the state of the battery charge. Graph B, "Charging Current".

d) Charge control circuit

If the electrical system is intact, the charge control indicator must go out in the speed range from 600-800 revolutions/min.

ELECTRICAL SYSTEM

Operating Conditions:

- Permissible operating temperatures: -20 to 70°C (measured on the governor surface)
- An intact earth connection must exist between the governor and the engine, and also between the governor and directly attached external construction (no painted or enamelled assembly surfaces).

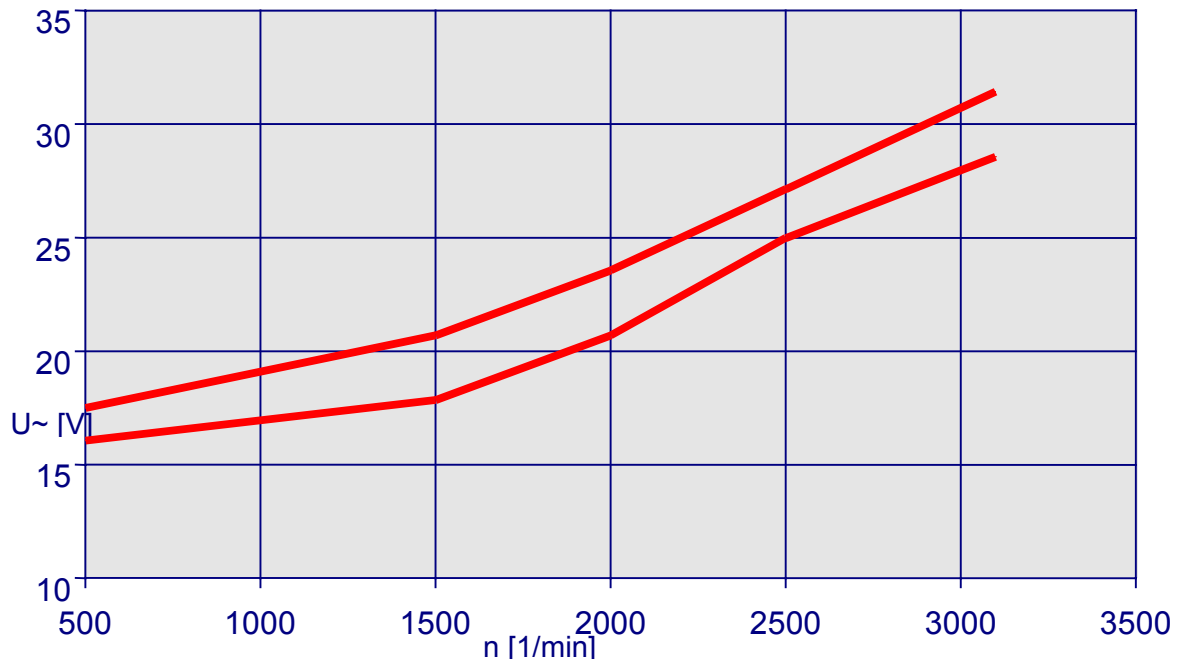
Hazards / Causes of Failure

Battery wrongly poled		Damage to charging control circuit
Battery is defective or discharged to minimum		Governor is destroyed in a short time.
Battery is disconnected while the engine is running (load shedding)		Governor is destroyed in a short time.
Charging with start aid cable when battery is defective or discharged to minimum		Governor is destroyed in a short time.
Load shedding when the start aid cable is removed.		
Welding work on the equipment (loosen all plug connections and battery cables beforehand)		Governor is destroyed in a short time.
Manual start with battery disconnected		Governor is destroyed in a short time.
Interruption of the earth connection between the governor housing and the engine		Governor is destroyed over a long period.

10.2 Flywheel - Dynamo 12V / Governor / Graph

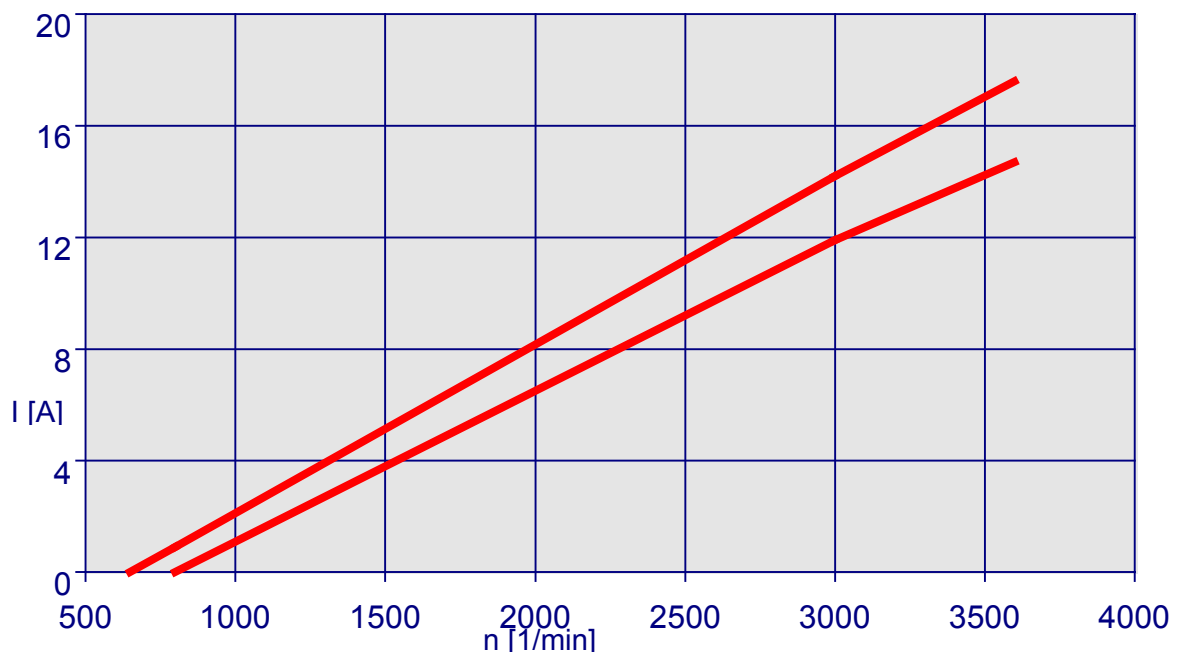
Idling Voltage **without** Governor

Graph A

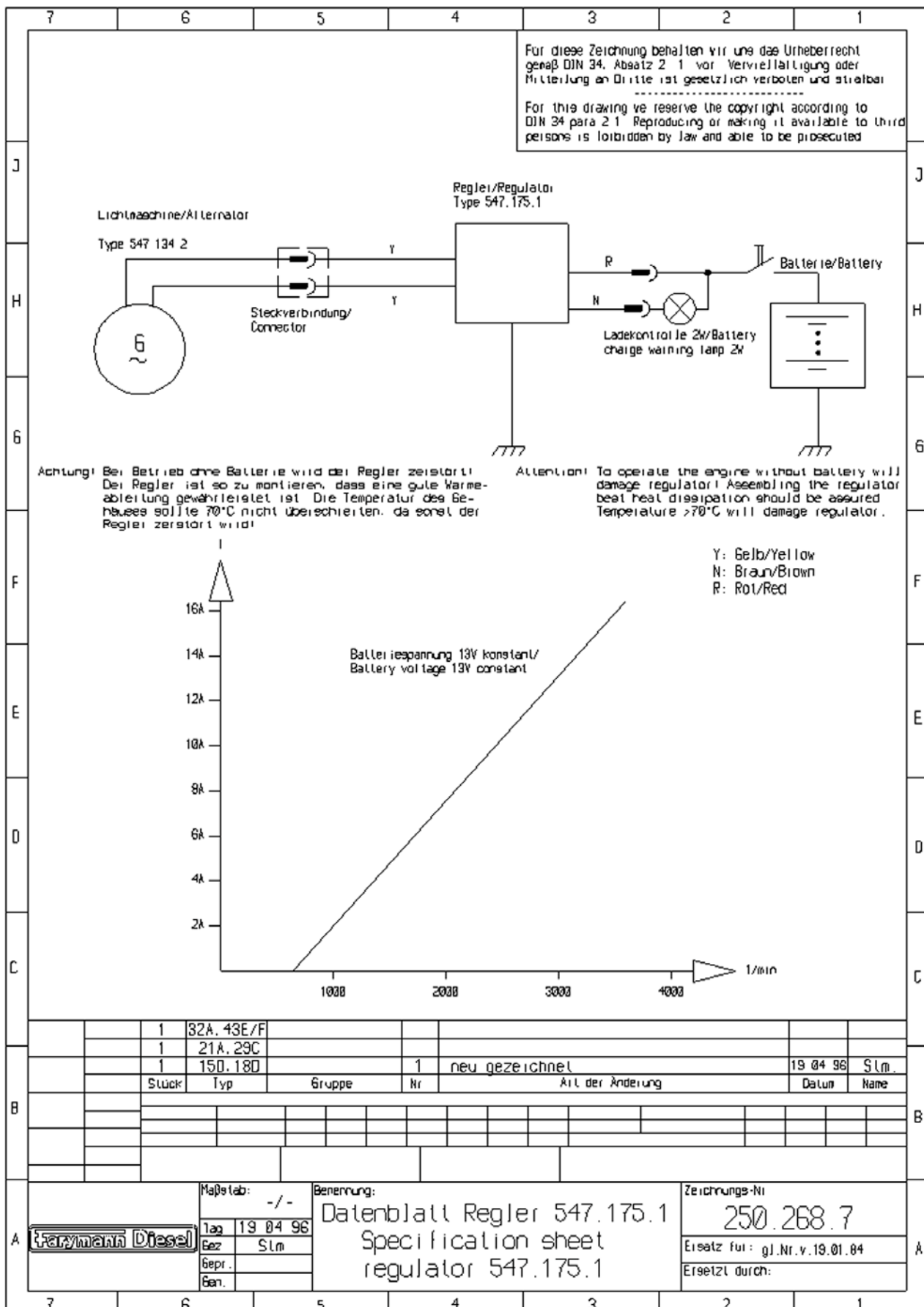


Charging Current

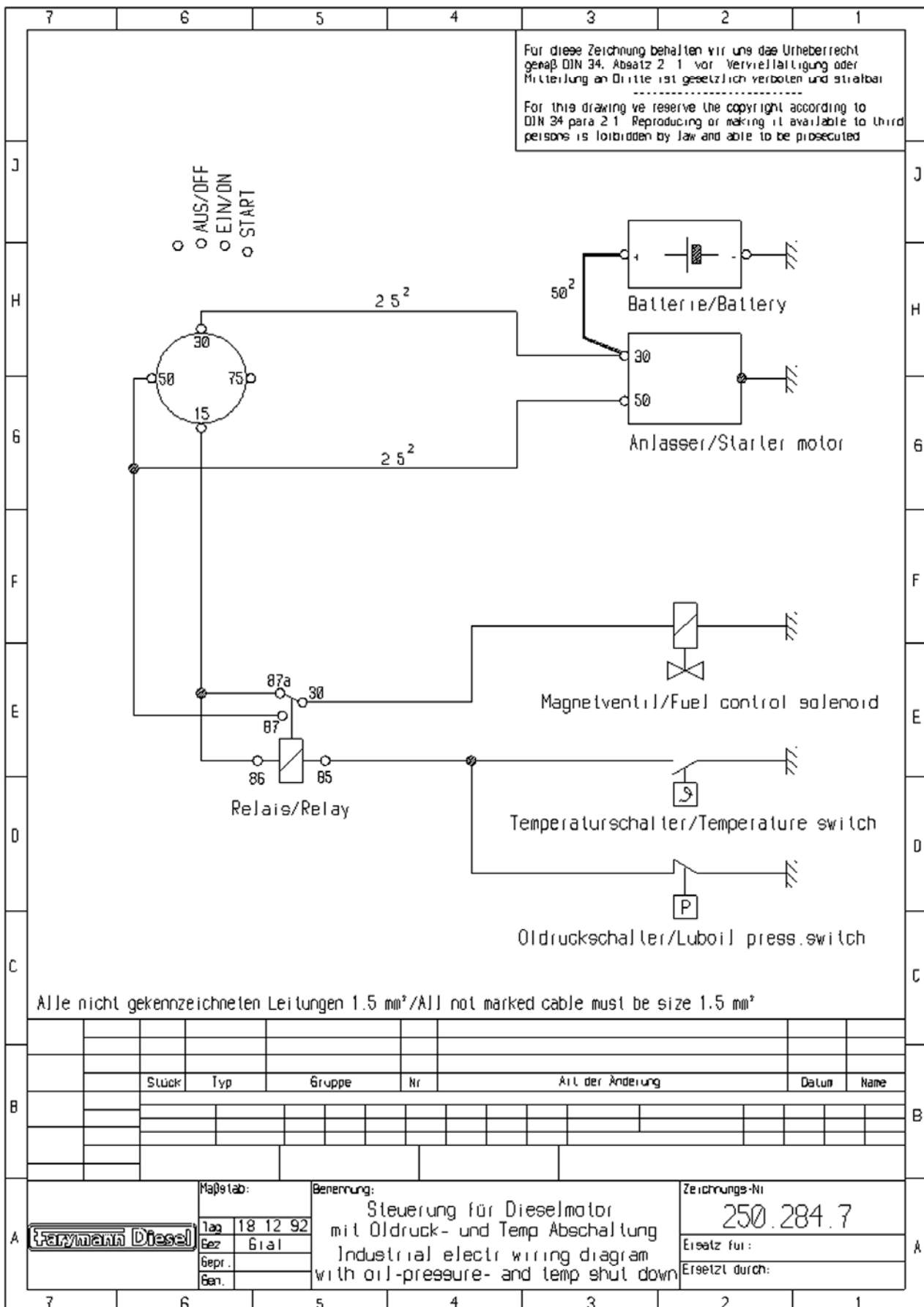
Graph B



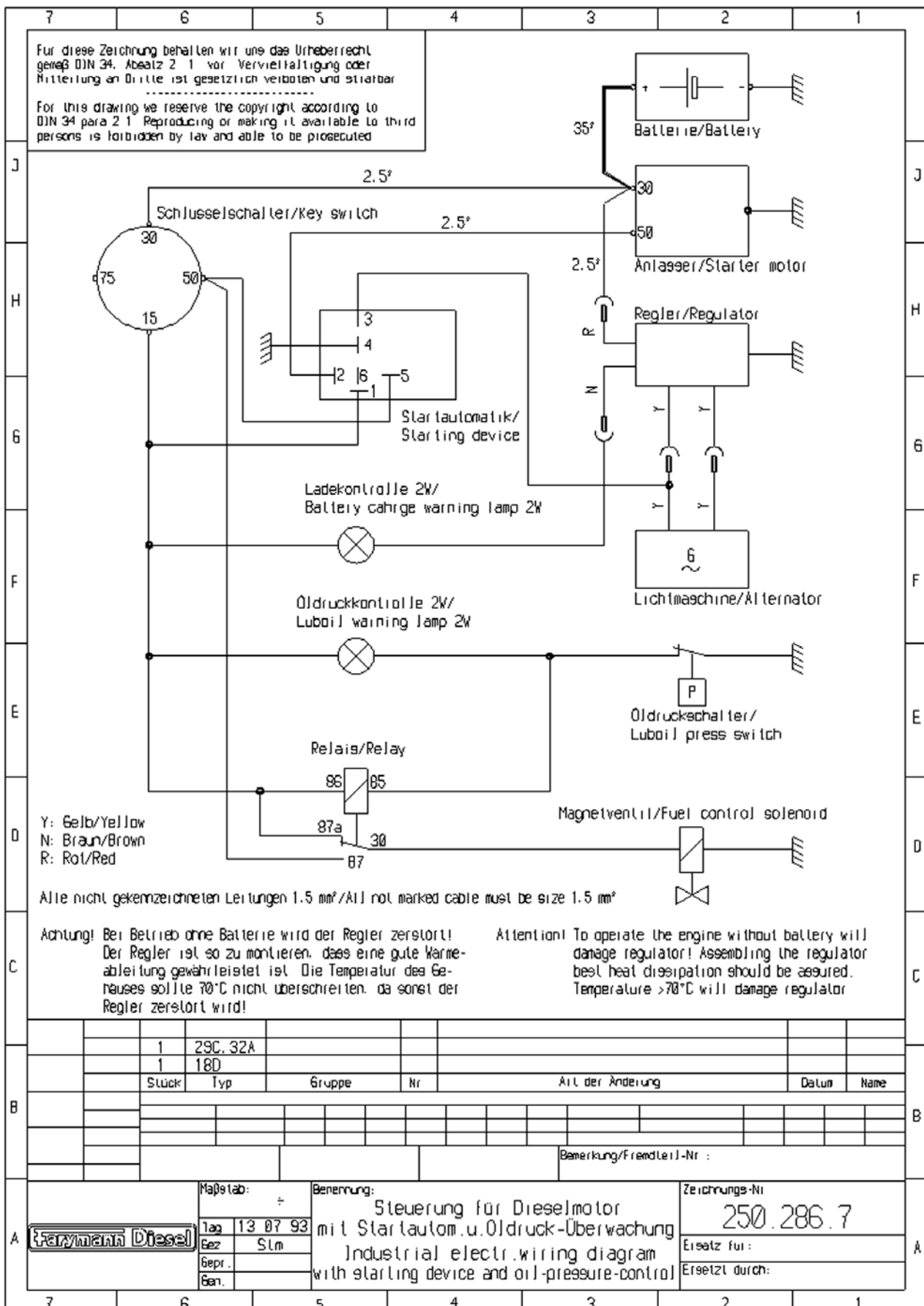
ELECTRICAL SYSTEM



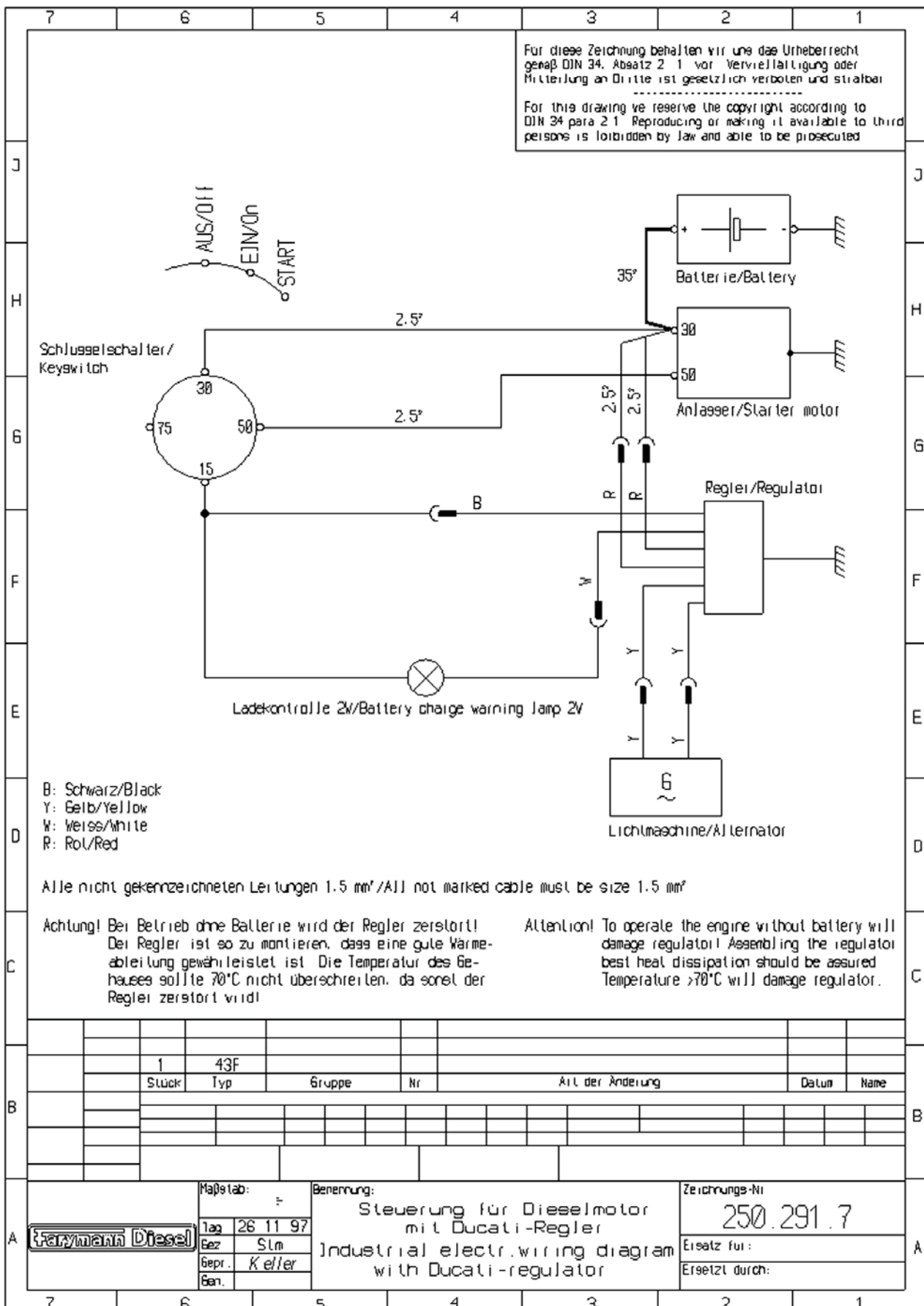
ELECTRICAL SYSTEM



ELECTRICAL SYSTEM

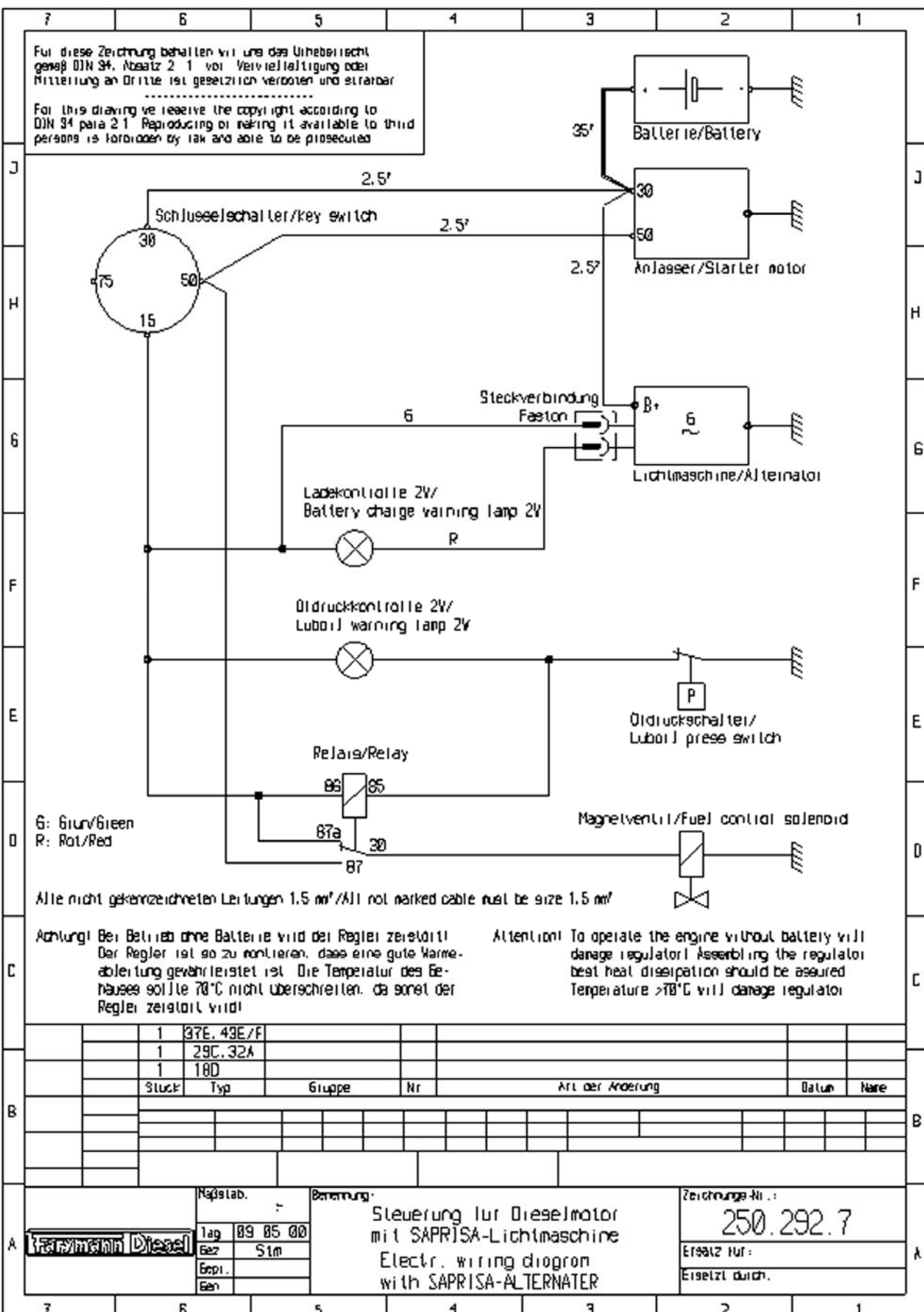


ELECTRICAL SYSTEM



ELECTRICAL SYSTEM

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TROUBLESHOOTING

11. Troubleshooting

This section aims to suggest possible causes and remedies for faults. Please note that this list can never be complete. Whenever there is a fault, the guiding principle should be: "Think Before You Act".

11.1 Engine will not start

Reason	Causes	Remedy
If the injection noise (rasping) cannot be heard: Fuel supply failure - turn the engine over by hand cranking, and listen for the characteristic rasping noise in the injector.	No fuel in tank. Acceleration lever at stop. Vent valve in tank cap blocked. Fuel line blocked. Fuel filter clogged. Broken fuel line or leaking connections. Vapor lock (fuel too hot). Paraffin precipitation in fuel (in cold seasons)	Fill with fuel; no venting needed. Set lever to full load Renew cap Check lines. Renew filter. Renew pipe / tighten connections. Cool the fuel. Drain and flush system, renew fuel filter. Use winter fuel.
If the rasping noise can be heard:	Faulty injector nozzle. Faulty injector pump. Gasoline instead of diesel in tank. Air intake blocked.	Check / repair / renew nozzle. Check / repair / renew pump. Drain gasoline, flush and fill with diesel. Check intake system. Change filter insert.
Poor compression	Incorrect valve clearance. Decompression device defective. Leaky valves. Valves sticking. Leaky cylinder head/ cylinder head seal. Piston rings stuck in grooves. Worn cylinder and piston.	Adjust valve clearance. Check / renew decompression device. Check / repair / renew valves. Free valves. Tighten nuts / renew seal. Check / free / renew the rings. Overhaul the engine.
Difficult to crank start the engine	Starting load too high. Lubricating oil too thick. Bearings seized. Piston seized.	Reduce load. Change oil; use correct viscosity. Overhaul engine. Overhaul engine.

TROUBLESHOOTING

11.2 Engine starts but fires intermittently or dies

Poor fuel supply	Fuel filter choked. Fuel line blocked. Leaking fuel lines. Water in fuel. Faulty injector nozzle. Faulty injector pump.	Renew filter. Check lines. Check lines / tighten connections. Drain fuel, fill with clean diesel. Check / repair / renew nozzle. Check / repair / renew pump.
Poor compression	Incorrect valve clearance. Worn valves. Valves sticking. Piston rings stuck in grooves. Worn cylinder and piston.	Adjust valve clearance. Overhaul cylinder head. Free valves. Check / free / renew rings. Overhaul engine.
Faulty intake and exhaust system	Restricted / blocked intake. Restricted / blocked exhaust.	Check / clean / exchange intake system. Check / clean / exchange exhaust system.

11.3 Poor engine performance and / or black smoke

Operating conditions	Engine overloaded. Power reduction due to altitude, and/or increased intake temperature has been ignored.	Reduce load. Fault search on equipment. Better operating conditions.
Poor fuel supply	Gasket under injector nozzle missing, or too many installed. Fuel filter blocked. Faulty injector nozzle. Faulty injector pump.	Install gasket / Correct number of gaskets. Renew filter. Check / repair /renew nozzle. Check / repair / renew pump.
Out of adjustment	Incorrect valve clearance. Incorrect end of delivery. Incorrect valve control timings. Piston installed wrongly.	Adjust valve clearance. Adjust end of delivery. Check gear wheel setting mark. Correct piston installation.

TROUBLESHOOTING

11.3 Poor engine performance and/or black smoke

Dirty engine	Dirty air filter. Excessive oil carbon deposits on piston and cylinder head.	Clean / renew filter. Decoke components / change vent valve.
General Engine Condition	Worn piston rings. Worn piston and cylinder. Worn bearing.	Renew rings / check air filter. Overhaul engine. Overhaul engine.

11.4 Imperfect operating behaviour

Overheating	Engine overloaded. Cooling fins dirty. Cool air intake obstructed. Short circuit of cooling air. Oil level in crankcase is too high. Faulty injector nozzle.	Reduce load. Clean cooling fins. Remove obstruction. Improve cooling air flow (check engine installation). Drain to proper level. Check / repair / renew nozzle.
Knocking Noises	Oil carbon deposits on piston. Injector needle sticking. Advanced ignition. Broken piston rings. Worn piston and cylinder. Worn bearings. Loose flywheel. Gasoline mixture in tank.	Decoke. Fit new nozzle. Check/adjust end of delivery. Fit new rings. Overhaul engine. Overhaul engine. Tighten flywheel nut. Change fuel.
Major fluctuations in speed (RPMs)	Overheating. Air in fuel. Governor sticking or faulty. Fuel filter choked. Regulating lever sticking or faulty.	See above. Check the fuel system for leaks / check the return line. Check / repair / renew governor. Renew filter. Check / renew.
Engine stops suddenly.	Empty fuel tank. Vent valve in tank cap is blocked. Vapor lock (fuel too hot). Choked injection nozzle.	Fill with fuel. Renew tank cap. Cool fuel. Check / repair / renew nozzle.

TROUBLESHOOTING

11.4 Imperfect Operating Behaviour

Engine stops suddenly	Fuel pipe broken. Seized piston. Seized crankshaft bearing.	Renew pipe. Renew piston and cylinder. Repair / renew crankshaft and bearings.
Blue smoke from engine	Oil level in oil bath air filter too high. Faulty vent valve in cylinder head. Sealing ring damaged on intake valve guide. Worn valves / valve guide. Worn piston / cylinder.	Fill to proper level. Renew valve. Renew sealing ring. Overhaul engine. Renew.
White smoke from engine	Ignition too late. Injector nozzle is worn.	Check / adjust end of delivery. Renew nozzle.
Oil pressure warning light on	Oil pressure warning lamp is defective. Oil level is too low. Defective oil pressure switch.	Exchange warning lamp. Measure oil level; if necessary, top up oil. Exchange.
Oil pressure is too low	Overpressure valve is defective. Dirty ball seat in overpressure valve. Oil filter is clogged. Lubricating oil pump is faulty.	Check, clean, exchange if necessary. Check, clean, exchange if necessary. Exchange. Check, clean, exchange if necessary.
Cold starting problems	Acceleration lever not at maximum stop buffer. Lubrication oil too thick. Crank handle defective. Paraffin precipitation in fuel.	Adjust. Change to correct viscosity. Check crank handle. Use winter fuel / and/or drain and flush system. Renew fuel filter.

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